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TO: John Hughes, Project Manager, RMI Environmental Services (RMIES)

FROM: Todd Struttmann, Sharp and Associates, inc. (SHARP)
Dave Lawton, SHARP
Kevin Smith, SHARP

SUBJECT: Correlation of Geology with Contamination within the Former Evaporation Pond Waste Management Unit (FEP WMU) at the RMIES Main Extrusion Plant Site (Site) in Ashtabula, Ohio.

DATE: July 7, 2003 (Revised July 25, 2003)

Sharp and Associates, Inc. (SHARP) is pleased to provide Figures 1 through 30, correlating the geological units defined in the report of the Phase III Groundwater Investigation at the RMI Extrusion Plant Site with contaminant concentrations that exceed cleanup criteria in the FEP WMU. These figures have been prepared at the request of John Hughes to support his determination of the correlation between geologic sub layers and contamination. The goal of this effort is to determine whether there is a field indicator that will help in the segregation of soils during the excavation of the FEP WMU. The Cross Sections, Structure Maps and Isoconcentration Maps confirm that the majority of the contaminants that exceed the current cleanup standards are located above the gray till unit in the FEP WMU. Based on the analytical data provided by RMIES, Total Uranium and TCE exceed the cleanup criteria primarily in the surface fill materials, near surface silt lenses, and in the brown till that extends to a maximum depth of less than twelve feet. Below the brown till, TCE and Total Uranium only exceed cleanup criteria in relatively small area in the vicinity of the wick drain system. Tc-99 only exceeds the cleanup criteria in an isolated area of near surface fill.

Scope of Work

The scope of work for this evaluation of the correlation between contamination and geologic sub layers included the following:

- modify up to 7 of the existing cross sections adding the chemical data (Uranium, Tc-99 and TCE) to show visually the correlation between the contamination and geologic subunits units;
- provide 2-d surface of the top of the unoxidized till, base of silt, base of fill;
- provide a 2-dimensional surface of the gross silt isopach , gross fill isopach;
- provide isoconcentration maps of TCE, U and Tc-99 for all data, Fill only, Silt only and data without silt and fill in the brown and gray till units;
- participate in 2 conference calls with RMIES project manager for the soils excavation, Argonne Laboratories representative, and the RMIES project manger for the groundwater investigation; and
- provide a letter accompanying the figures that describes the results.

This scope of work did not include determination of volumes of contamination. This volume determination was in a separate proposal.

Geologic Cross Sections

Figures F-1 through F-10 were generated using existing boring logs and monitoring well logs in the vicinity and within the FEP WMU. The elevations of the distinct geologic units including fill materials, brown and gray mottled silty clay, silt, brown silty clay, gray silty clay, and bedrock were identified and posted on the cross section using 2002/2003 survey data. Total Uranium (U), Tc-99, and TCE concentrations from samples collected at the time the borings were installed are posted on the completed cross sections. The results of samples that exceed the cleanup criteria are outlined in red. Figure F-1 shows the location of the nine cross sections (Figures F-2 through F-10).

Discussion of Data

Figure F-2 – Geologic Cross-Section E-E'

- Total Uranium exceeds cleanup criteria (30 pCi/g) primarily in the surface fill unit.
- Total Uranium exceeds cleanup criteria in the brown silty clay unit in only three borings (L-22, BH2B and BH2C).
- Tc-99 exceeds cleanup criteria (65 pCi/g) in only one sample collected from fill material from boring L-22.
- Total Uranium, Tc-99, and TCE (criterion of 23 ug/g) do not exceed the cleanup criteria in any samples collected from the gray silty clay unit except at location T-1 where the sample taken at the top of the unit exceeded the criteria for TCE This boring was placed in the area of the vertical wick drains.

Figure F-3 – Geologic Cross-Section F-F'

- Tc-99 exceeds the cleanup criteria in samples collected from borings L-1, T-3, and MW-309 in this cross section. All of these borings are in the area of the wick drains.
- TCE exceeds the cleanup criteria only in borings collected within the footprint of the wick drain.

- Total Uranium slightly exceeds cleanup criteria in samples collected in the gray silty clay in only one boring in this transect (L-6).

Figure F-4 – Geologic Cross-Section G-G'

- Total Uranium only exceeds cleanup criteria in the fill material in borings L-19 and BH-17.
- TCE and Tc-99 do not exceed cleanup criteria in any samples collected from borings included in this cross section.

Figure F-5 – Geologic Cross-Section H-H'

- TCE and Tc-99 do not exceed cleanup criteria in any samples collected from borings included in this cross section.
- Total Uranium exceeds cleanup criteria in three samples collected in saturated silt from borings T-4, L-8 and L-11.
- Total Uranium exceeds cleanup criteria in three samples collected in fill material in borings L-5 and L-11.
- Total Uranium, Tc-99, and TCE is not present above cleanup criteria in any samples collected from the brown or gray silty clay from borings included in this cross section.

Figure F-6 – Geologic Cross-Section I-I'

- Tc-99 do not exceed cleanup criteria in any samples collected from borings included in this cross section.
- TCE exceeds the cleanup criteria in the original boring for monitoring well MW-309.
- Total Uranium exceeds cleanup criteria in two samples collected from borings L-11 and L-12 within the fill material.
- Total Uranium slightly exceeds cleanup criteria in a saturated silt lens in boring L-11.
- Total Uranium, Tc-99, and TCE is not present above cleanup criteria in any samples collected from the brown or gray silty clay from borings included in this cross section.

Figure F-7 – Geologic Cross-Section J-J'

- Total Uranium exceeds cleanup criteria in only one sample collected from the brown and gray mottled silty clay in boring L-16.
- Total Uranium, Tc-99, and TCE is not present above cleanup criteria in any samples collected below the fill material in any borings included in this cross section.

Figure F-8 – Geologic Cross-Section K-K'

- Tc-99 and TCE only exceed cleanup criteria from samples collected from borings within the footprint of the wick drain.

- Total Uranium exceeded cleanup criteria in only one sample collected outside of the footprint of the wick drain. This sample was collected from a saturated silt lens in boring L-8.
- Total Uranium exceeds cleanup criteria in the gray silty clay in one boring included in this cross section (L-9). This boring is located within the footprint of the wick drain system.

Figure F-9 – Geologic Cross-Section L-L'

- TCE and Tc-99 do not exceed cleanup criteria in any samples collected from borings included in this cross section.
- Total Uranium exceeds cleanup standards in six samples collected from within the fill material from borings included in this cross section.
- Boring L-25 had one sample collected from the gray silty clay that exceeded the cleanup criteria. This sample may not be representative based on results of samples collect above and below this sample interval due to poor sample recovery reported on the original boring log. From discussions with John Hughes, this result may be from another source of Total Uranium.
- Total Uranium did not exceed the cleanup criteria in any other samples collected from the silt, brown silty clay or gray silty clay in borings included in this cross section.

Figure F-10 – North FEP WMU Transect

- Total Uranium exceeded cleanup criteria in three samples collected from buried topsoil in borings BH-17, BH-18, BH-19, and BH-20.
- Total Uranium, Tc-99, and TCE did not exceed cleanup criteria in any other samples collected from borings included in this cross section.

Description of Structural maps

Figure 11 is a structure map portraying the top of the unoxidized gray till. This map is the same contouring as previously presented, with coverage limited to the area within and immediately around the FEP WMU. All of the subsequent geologic and isoconcentration maps are shallower in the section than this surface.

Figure 12 is a structure map that portrays the base of the silt units within the brown weathered till. It is based on the lowest occurrence of silt in any boring or well where it was identified as distinct from the surrounding till.

Figure 13 portrays the base of the topsoil/fill. It is recognized that there are compositional differences within this section because of site activities that have included grading and fill with different materials at different times, however those compositional differences are undifferentiated with regard to the base of the unit shown here.

Figure 14 is a gross isopach of the silt units within the brown weathered till. By definition the "gross" isopach map portrays the cumulative thickness of all silt units encountered within the brown weathered till section of each boring.

The thicknesses shown are based upon all available information in the area. Where silt was identified with a well or boring without defining the thickness, a default thickness of 1 foot was used for each silt interval that was described. Where the silt thickness was defined in more detail, that was used.

Figure 15 is a gross isopach of the topsoil/fill and portrays the cumulative thickness of the unit, undifferentiated with regard to the lithology variation within the unit.

Description of Isoconcentration maps

TCE

Figures 16 through 20 are the TCE isoconcentration maps for all data, fill only, silt only, brown till, and gray unweathered till, respectively. Observations of the data are as follows:

- The maximum concentration of TCE is in borings in or immediately adjacent to the Wick Drain area.
- There are three exceedances of TCE in the fill, from borings HRCc-4, HRCa-2, and boring MW-501. These exceedances ae in or adjacent the wick drain area.
- The major exceedances are in the Silt lenses (Figure 18). This is significant as the silt lenses have a higher hydraulic conductivity and are presumed to be the source of transport of TCE within the soil.
- There are exceedances within or immediately adjacent to the Wick Drains that extend to 20 feet below ground surface into the gray till (Figure 20). The TCE exceedance in L7 extends to the same depth as the wick drains (15 feet). The TCE exceedance in L1 extends to the 18-20 foot sample. The other exceedances are within 5 feet of the top of the interface between the brown and gray till.
- On all maps, the 23,000 ug/kg contour opens to the east of the FEP WMU area. This is an artifact of the way the kriging algorithm grids the concentration gradient and of the lack of data points to the east of the FEP WMU.

Total Uranium

Figures 21-25 provide a 2-D display of the Total Uranium concentrations. Figures 21, 22, 23, 24, and 25 includes all data, Fill only, silt only, brown till, and gray unweathered till, respectively. A dominant feature is the high concentration in boring L-25 in the fill. Based on discussions with John Hughes, this is believed to not be related to the FEP WMU, but potentially a secondary source adjacent to a building doorway. The data from L-25 is honored in these figures, but skews the overall impression of the data. The observations of the data are as follows:

- The Total Uranium has the highest concentrations in the Fill.
- The Total Uranium above 43 mg/kg within the silt layer is in the southern and western half of the Wick Drain area and south of the wick drains near the original settling pond.
- The Total Uranium above 43 mg/kg in the brown till is predominantly within or adjacent to the Wick Drain area, but also extends to the south near the original settling pond.

- The only Total Uranium found above 43 mg/kg in the gray till is from boring L-25, discussed above as an area outside of the FEP WMU.

Tc-99

Figures 26-30 present Tc-99 isoconcentrations for all data, fill only, silt only, brown till, and gray unweathered till, respectively. There is very limited data that exceed the 65 pCi/g cleanup standard. This is limited to borings in the southwest corner of the FEP WMU, and borings HRCc-1 (immediately north of the wick drain area), and L-22, to the southeast of the wick drain area.

The exceedances shown on Figure 29 (Brown Till) are all found within the top section of the brown till, and may be related to the base of the topsoil/fill section. However the descriptions from these borings are limited with regard to this interval. and so the results in the brown till may be skewed. Tc-99 is not a significant driver for the cleanup of the section deeper than the top of the brown till.

Correlation Between Contaminants and Geologic Subunits

The objective of this scope was to determine whether there is a correlation between the presence of contaminants of concern and the geologic subunits at the sites. The observations from the data collected are listed below.

- Fill. TCE is present in the fill above standards in 2 borings, HRCc-4 and HRCa-2. Tc-99 is present above standards only in borings L-21, L-22 and HRC-a-3 (172 pCi/g). Boring L-9 is less than 5 feet from that boring and had a reported value of 64 pCi/g from the same section, indicating that there can be a large variation of Tc-99 values within a small area. Uranium has more exceedances in the fill than any other part of the section.. Fill is generally a Uranium issue only.
- Silts. – Elevated TCE concentrations are primarily located within the silt layers, although within the wick area it appears that TCE has migrated deeper into the section. Uranium appears to be mostly attenuated within the fill, and Tc-99 has not been detected above standards within the silts.
- Wick Drain Area – The vertical permeability has been greatly altered by installation of the wick drains. The presence of U is attenuated at the depth of the initial installation of wick drains (i.e, 15 feet bgs). TCE appears to have migrated downward in limited areas in or adjacent to the wick drain area.
- Brown till – TCE concentrations in this unit are confined to those borings within or immediately adjacent to the wick drains. The wick drains provide a vertical conduit for transport, thus it is not surprising to find the presence of TCE in this area. Total Uranium and Tc-99 are limited to the uppermost section of the brown till under the fill/topsoil section.
- Gray Till – TCE exceedances in this unit are confined to an isolated area within the Wick Drain Area. There are two borings grouped together adjacent to the east side of the wick drain area (HRCa-2 and MW-504) that also has TCE values above standards.

Conclusions and Recommendations

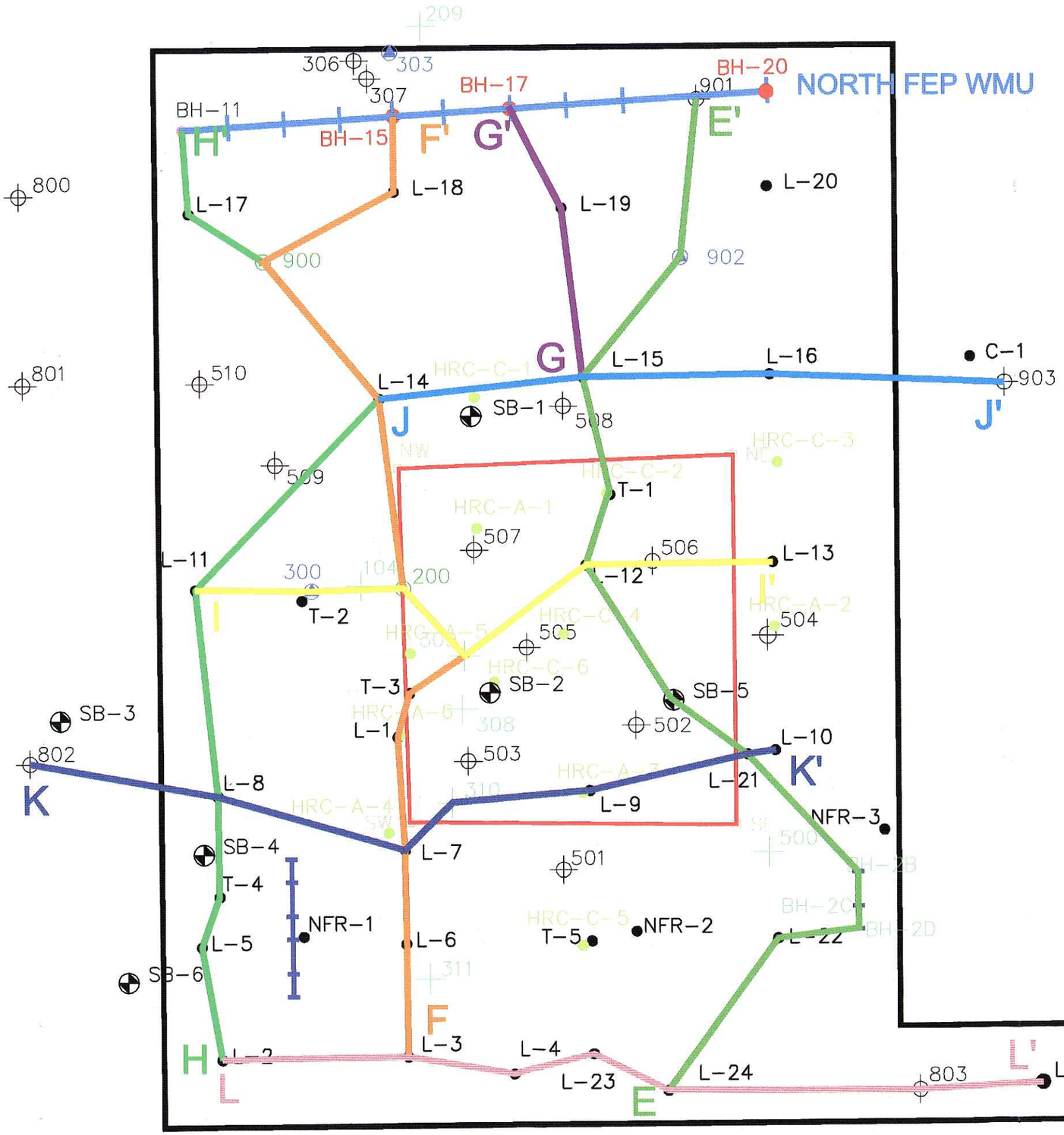
- There is a correlation between the geologic subunit and the contamination. The implication is that a field screening method based on geologic sub layers could be useful to help direct the excavation.
- The fill primarily a Uranium only issue.
- The wick drain area is a mixed waste issue (TCE and U).
- The TCE within silts is predominantly within the wick drain area but extends outside that area due to transport through the higher permeable silts.
- The Gray till is absent of TCE or U with the exception of an area directly below or immediately adjacent to the Wick Drains.

Recommendations

The next step is to take these correlations and generate volumes for soil removal based on the understanding of the geologic units and contaminants. The volumes should be in a format which can later be used to prepare engineering plan sheets for bidding the excavation work.

Cc: A. Lambacher, RMIES
M. Al-Quraishi, RMIES
R. Johnson, Argonne Labs

List of Figures Included:



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EXTRUSION PLANT SITE
WMU AREA
ASHTABULA,OH

CROSS-SECTION LOCATION MAP

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FIG1A.dwg

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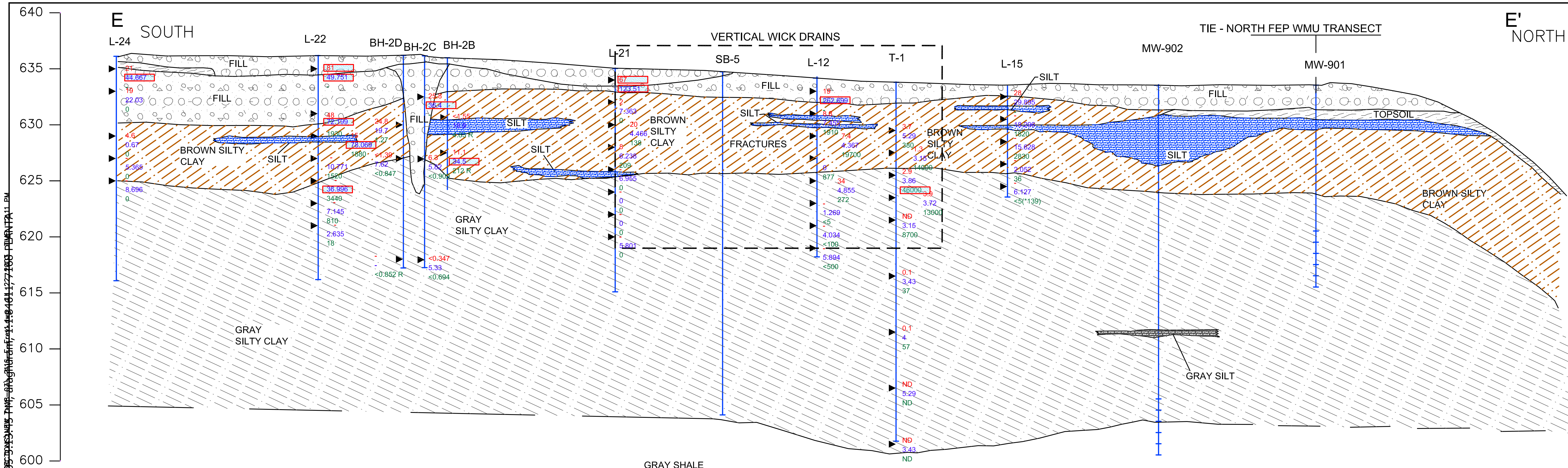

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XXX = TOTAL U IN SOILS, ug/g
XXX = TCE IN SOILS, ug/kg
▶ = AVERAGE SAMPLE DEPTH

TRENCH FILL MATERIALS
SURFACE FILL MATERIALS
BROWN AND GRAY MOTTLED SILTY CLAY
GRAY SILTY CLAY
BROWN SILTY CLAY
SAND
SILT
TOPSOIL-(SILTY CLAY)
CLAYEY SILT
CLAY
GRAY SILTY CLAY WITH IRON

(*) Duplicate result; unable to verify concentration.

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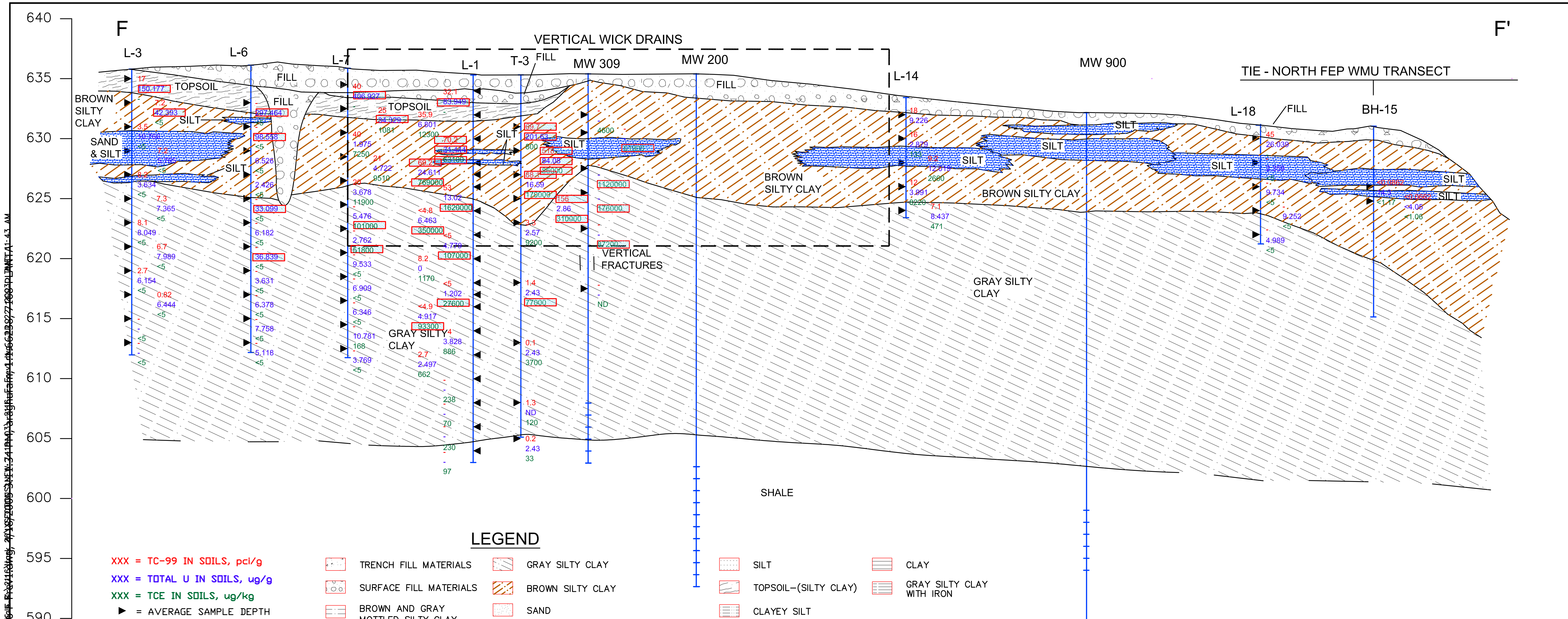

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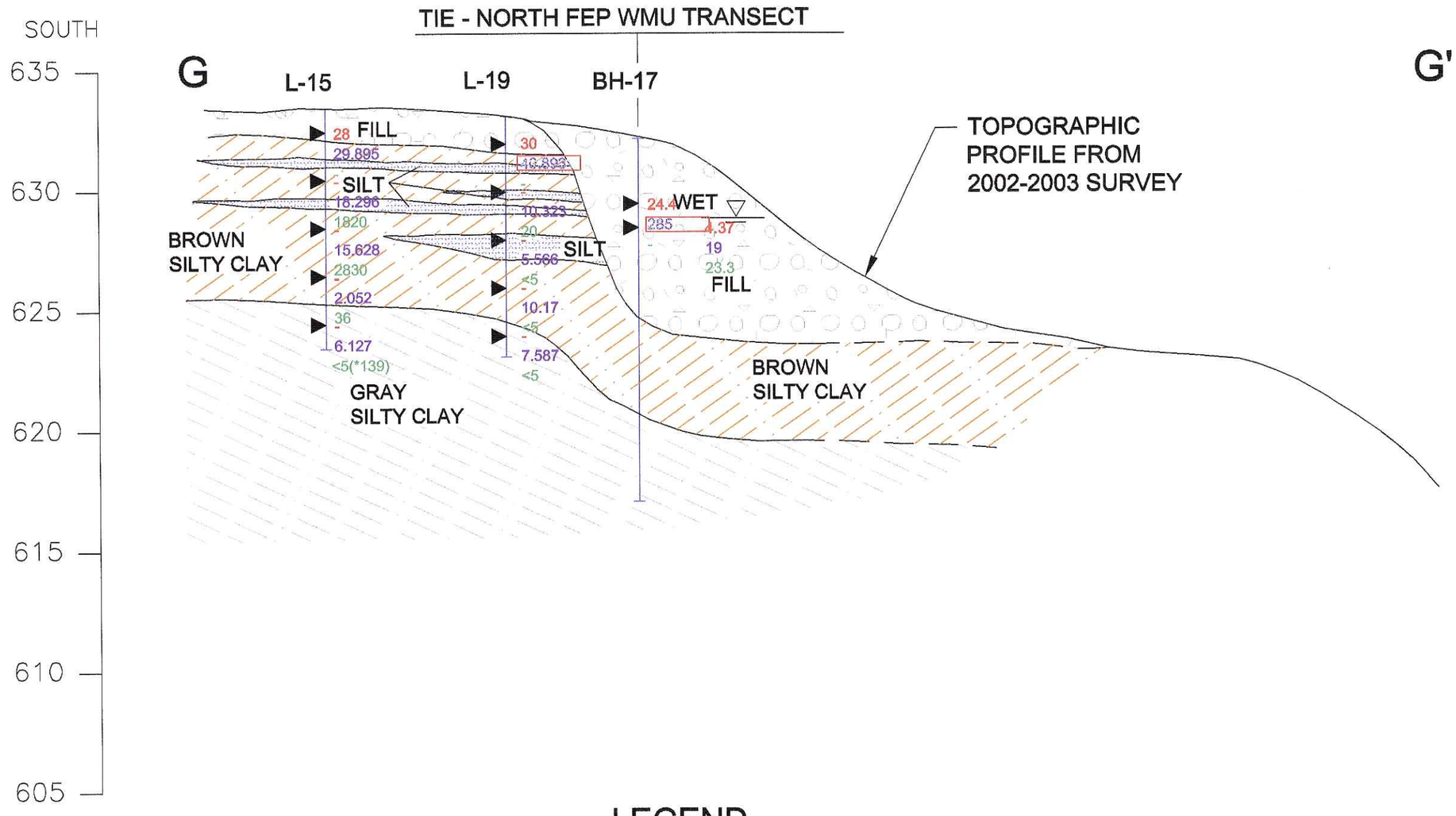

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- CLAY
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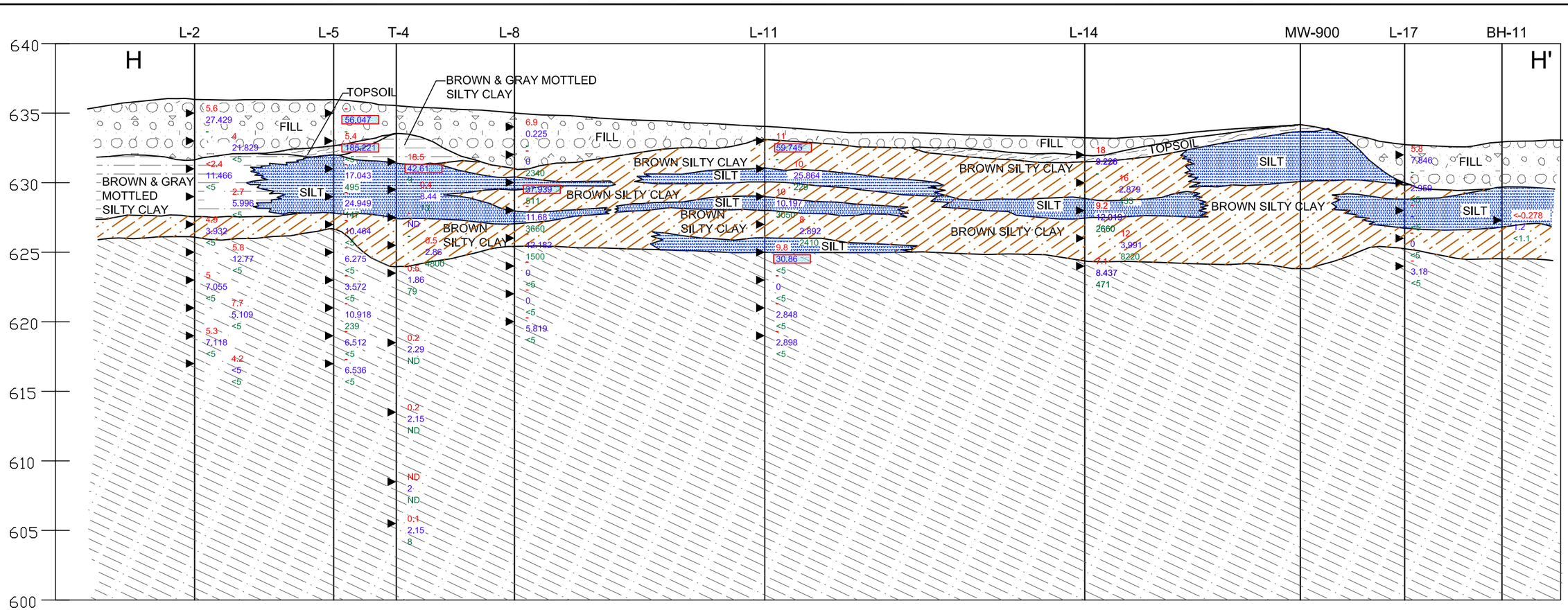

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- CLAYEY SILT
- CLAY
- GRAY SILTY CLAY WITH IRON

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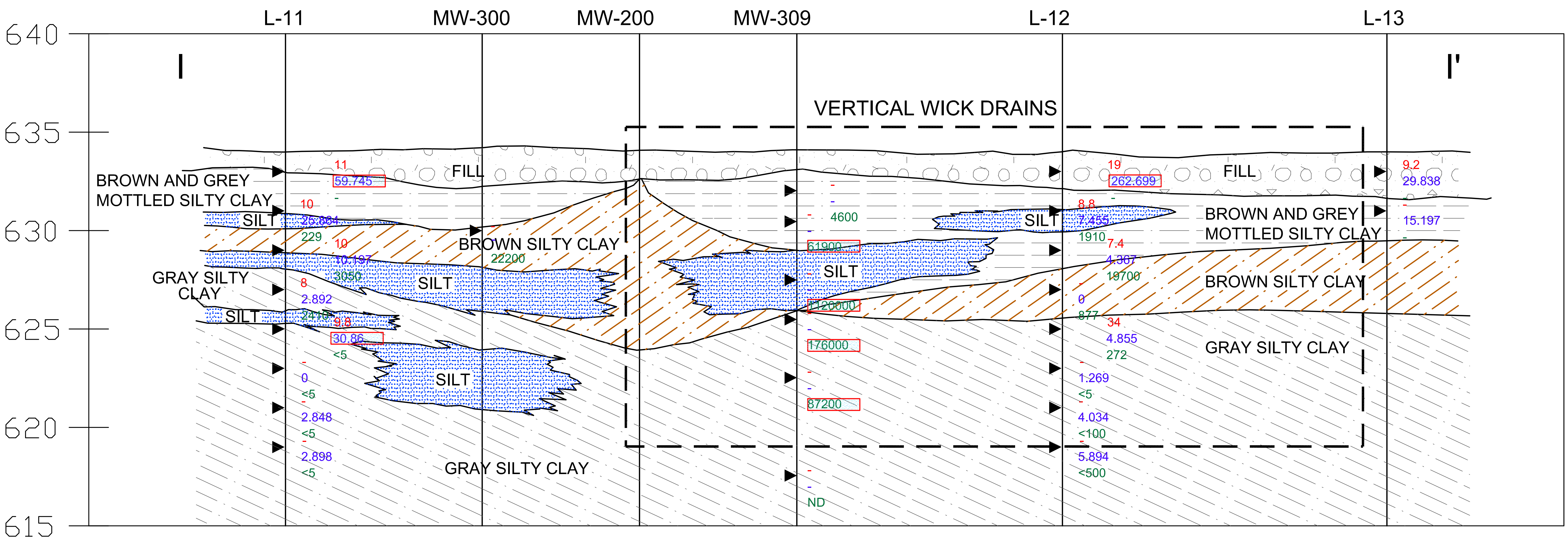

LEGEND

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SURFACE FILL MATERIALS

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GRAY SILTY CLAY

BROWN SILTY CLAY

SAND

SILT

TOPSOIL–(SILTY CLAY)

CLAYEY SILT

CLAY

GRAY SILTY CLAY WITH IRON

AGGREGATE BASE

SURFACE FILL MATERIALS

TRENCH FILL MATERIALS

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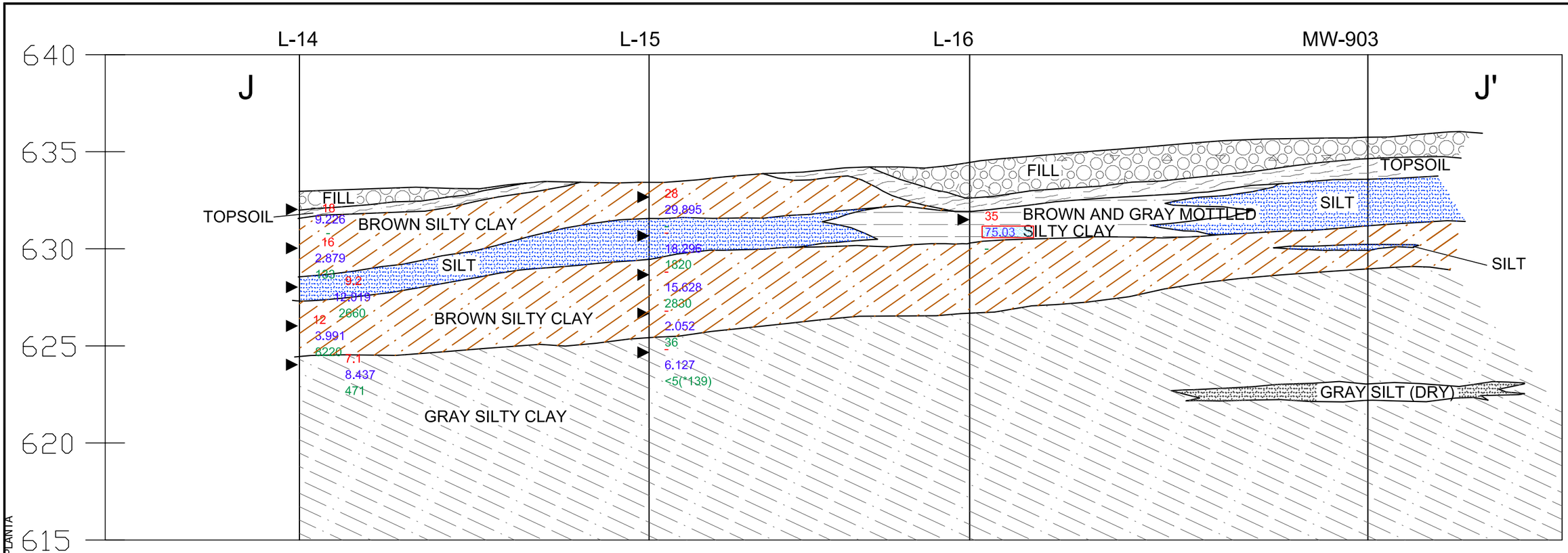

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- CLAY
- GRAY SILTY CLAY WITH IRON
- AGGREGATE BASE
- SURFACE FILL MATERIALS
- TRENCH FILL MATERIALS

(*) DUPLICATE RESULT; UNABLE TO VERIFY CONCENTRATION

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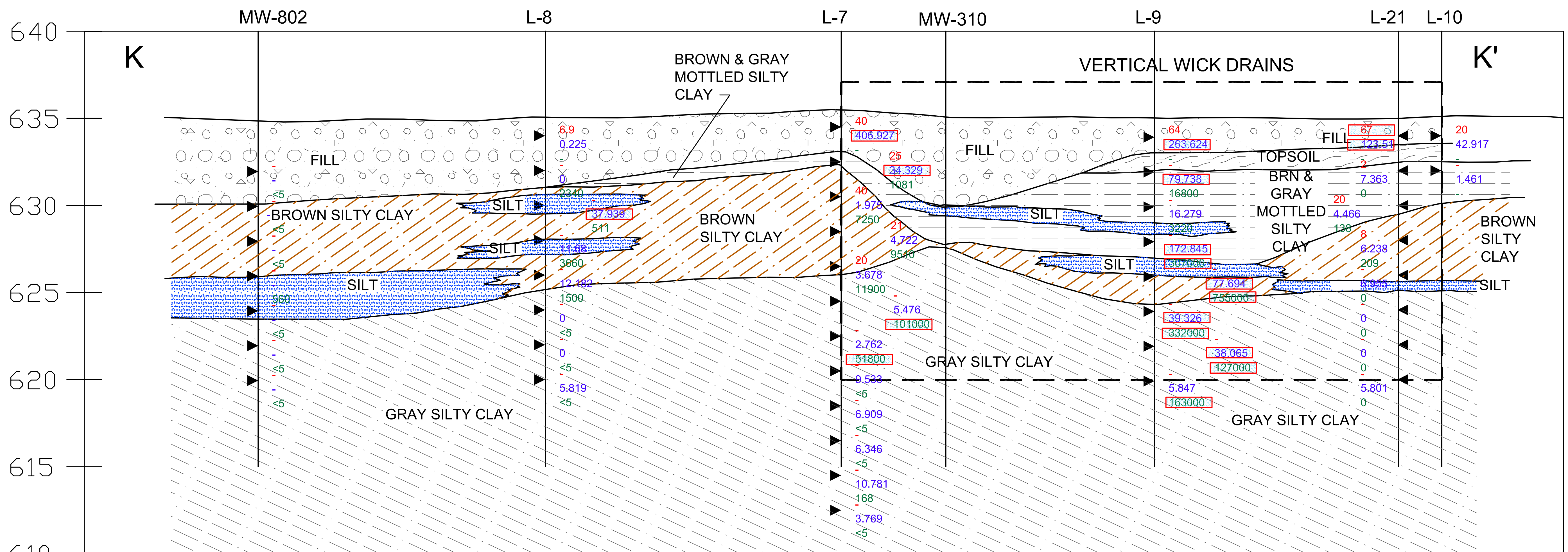

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TRENCH FILL MATERIALS

SURFACE FILL MATERIALS

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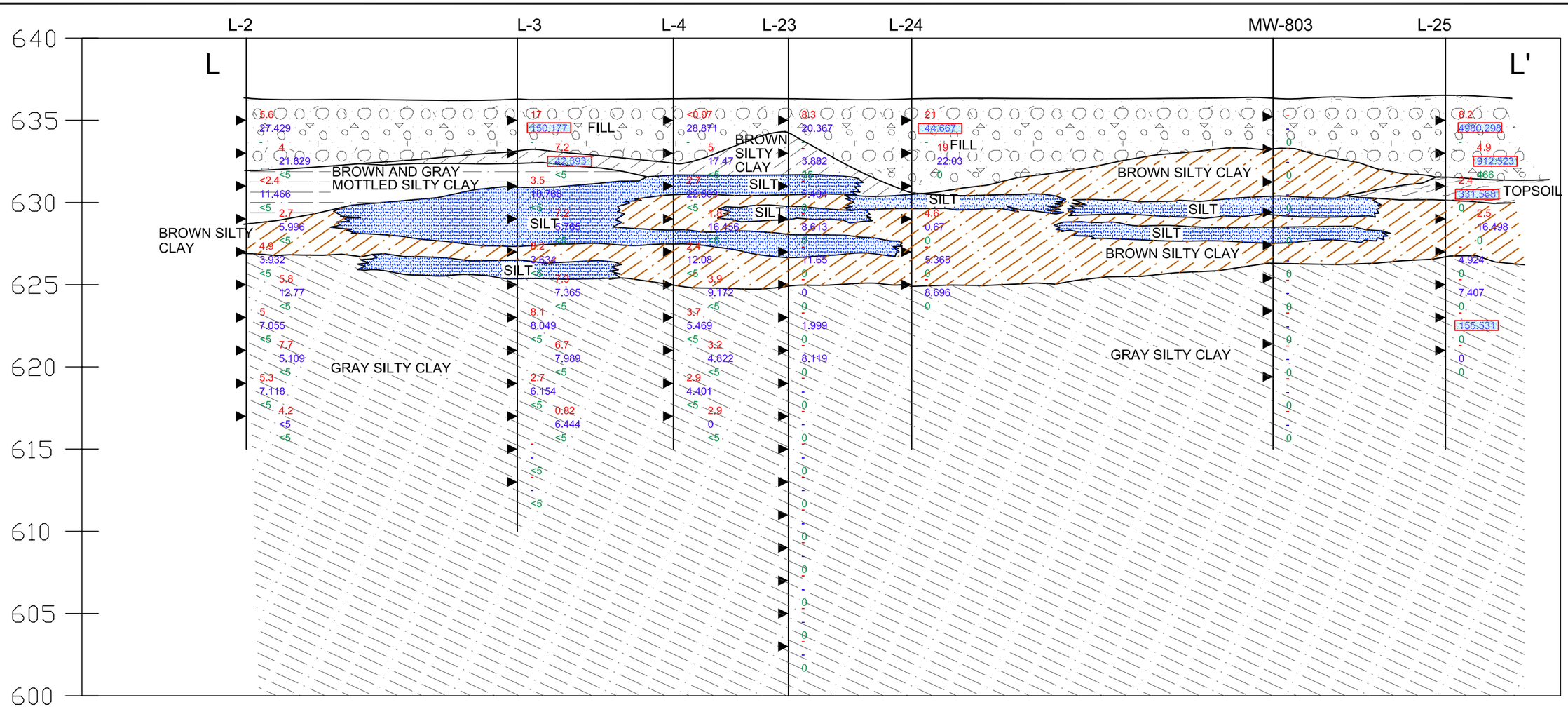

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- GRAY SILTY CLAY WITH IRON
- AGGREGATE BASE
- SURFACE FILL MATERIALS
- TRENCH FILL MATERIALS

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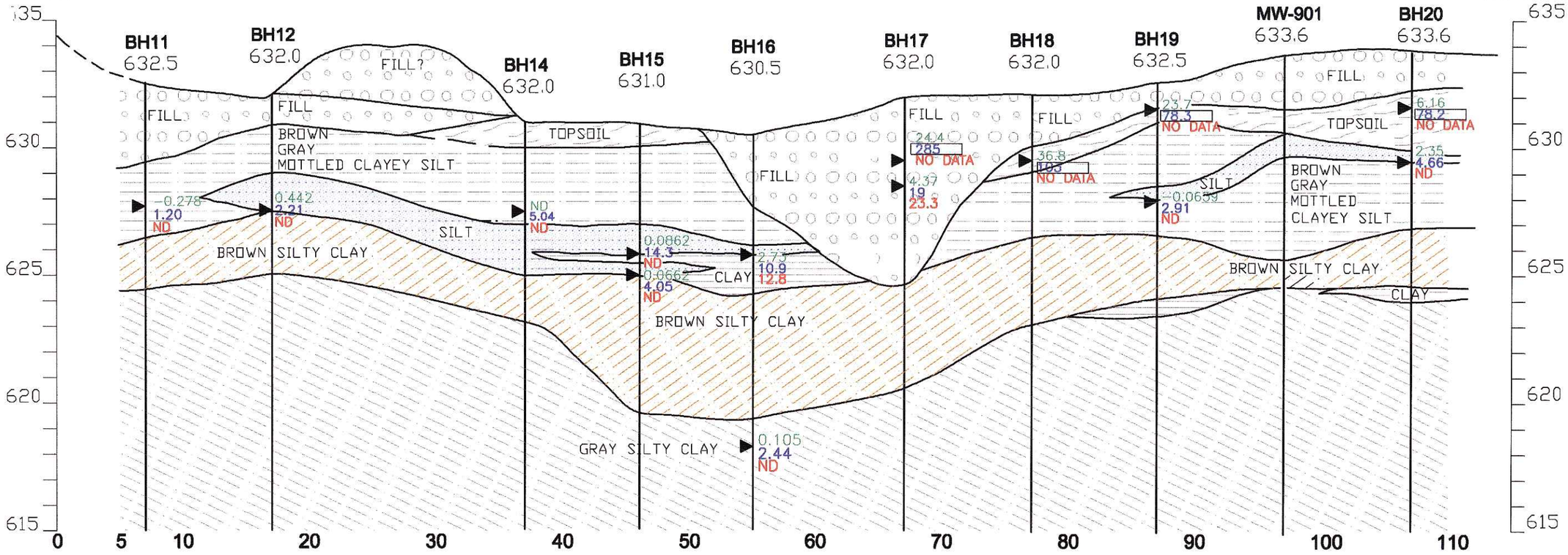


LEGEND

- FILL
- BROWN AND GRAY MOTTLED SILTY CLAY
- GRAY SILTY CLAY
- BROWN SILTY CLAY
- SAND
- SILT
- TOPSOIL–(SILTY CLAY)
- CLAYEY SILT
- CLAY
- GRAY SILTY CLAY WITH IRON

▶ AVERAGE SAMPLE DEPTH

ND = NON DETECT

XXX = TC-99 IN SOILS, pci/g

XXX = TOTAL U IN SOILS, ug/g

XXX = TCE IN SOILS, ug/kg

Rev.	Date	Description	Design	Drawn	Check

RMI ENVIRONMENTAL SERVICES
EXTRUSION PLANT SITE
ASHTABULA, OHIO

NORTH FEP WMU TRANSECT

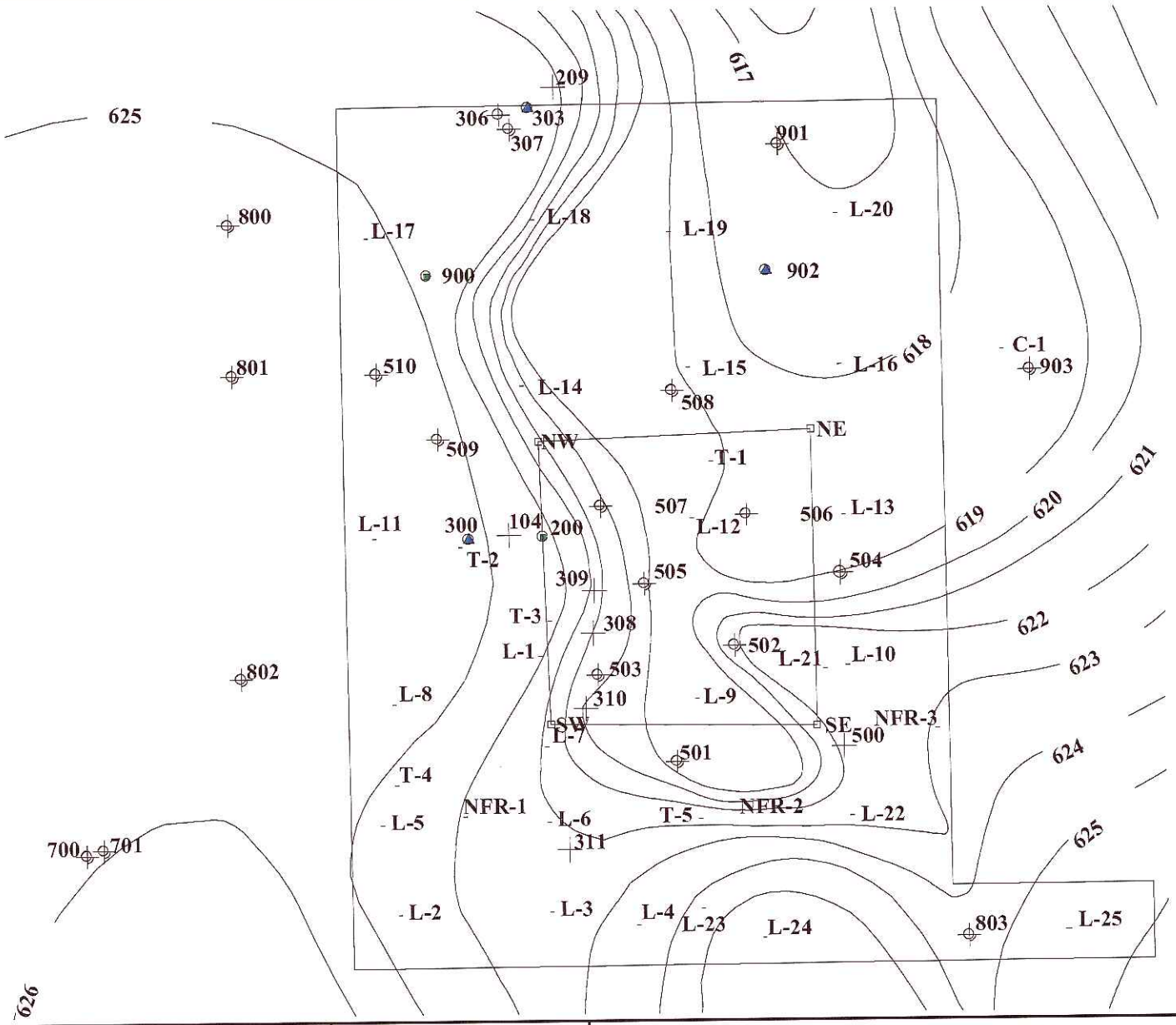
SHARP
AND ASSOCIATES, INC.
982 Crupper Avenue
Columbus, Ohio 43229
(614) 841-4650
Fax (614) 841-4660
www.sharpenv.com

File Name
WMU-T10.dwg

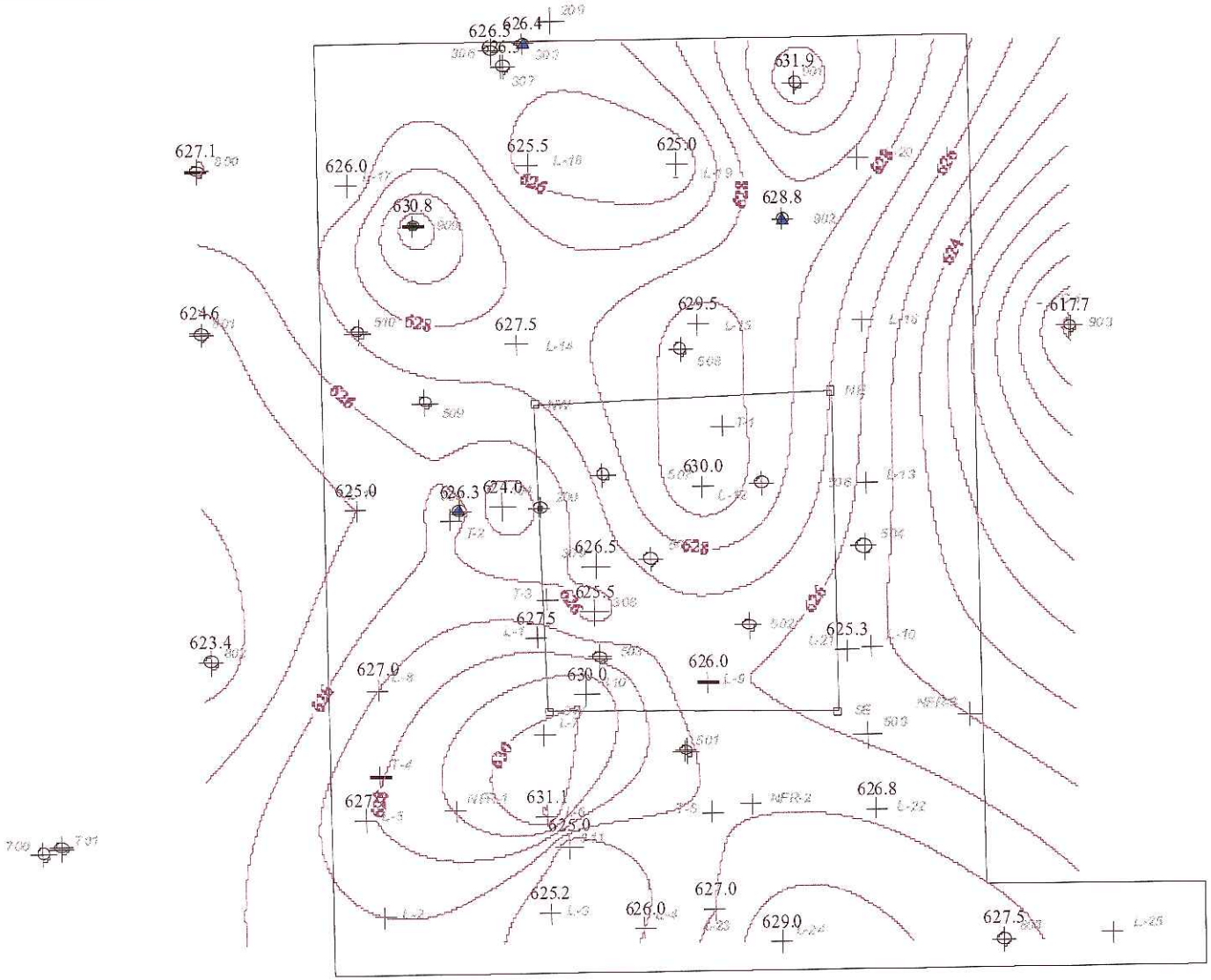
Project No.
2116

Sheet 10 of 27

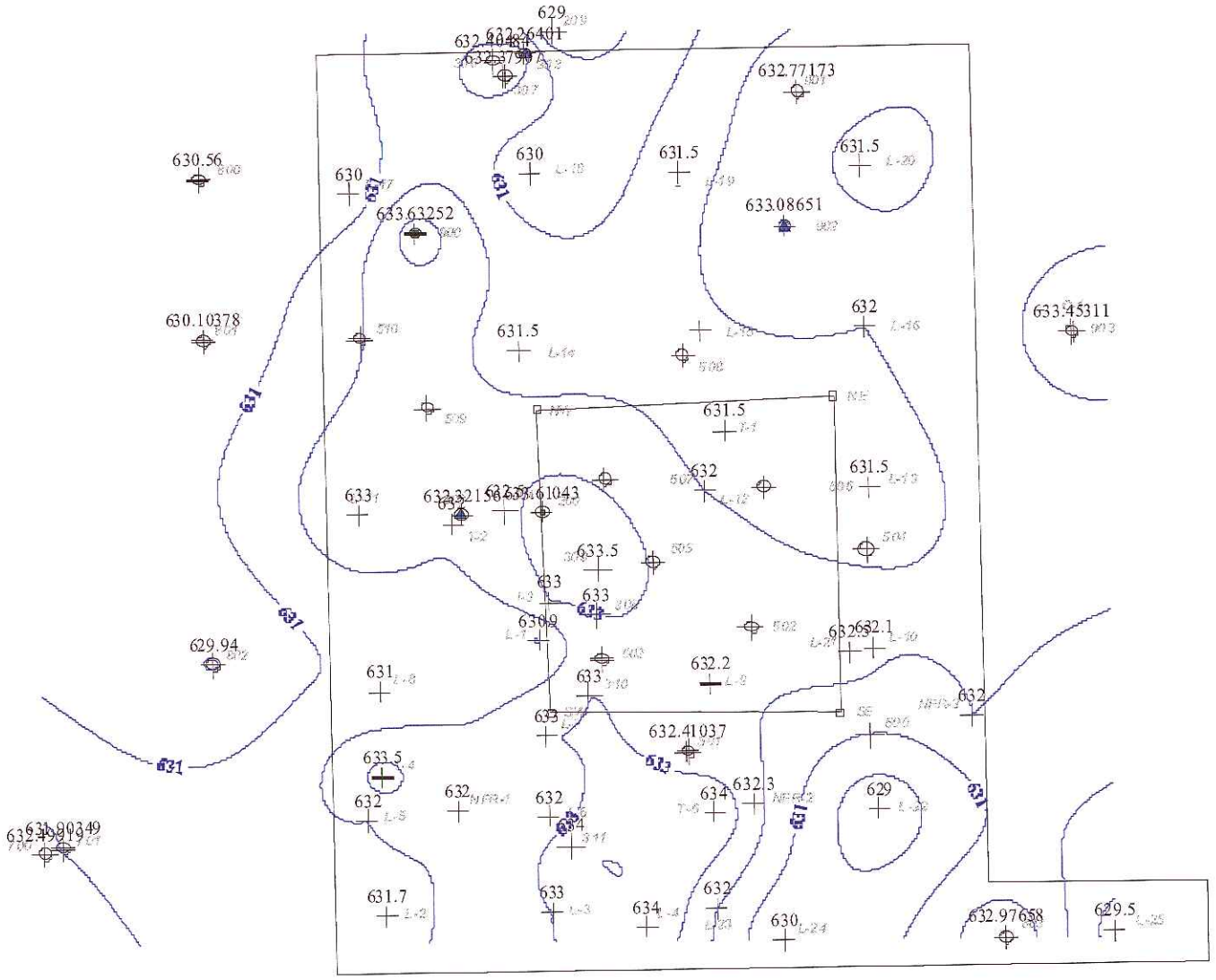
Drawing No.	Revision
F-10	0



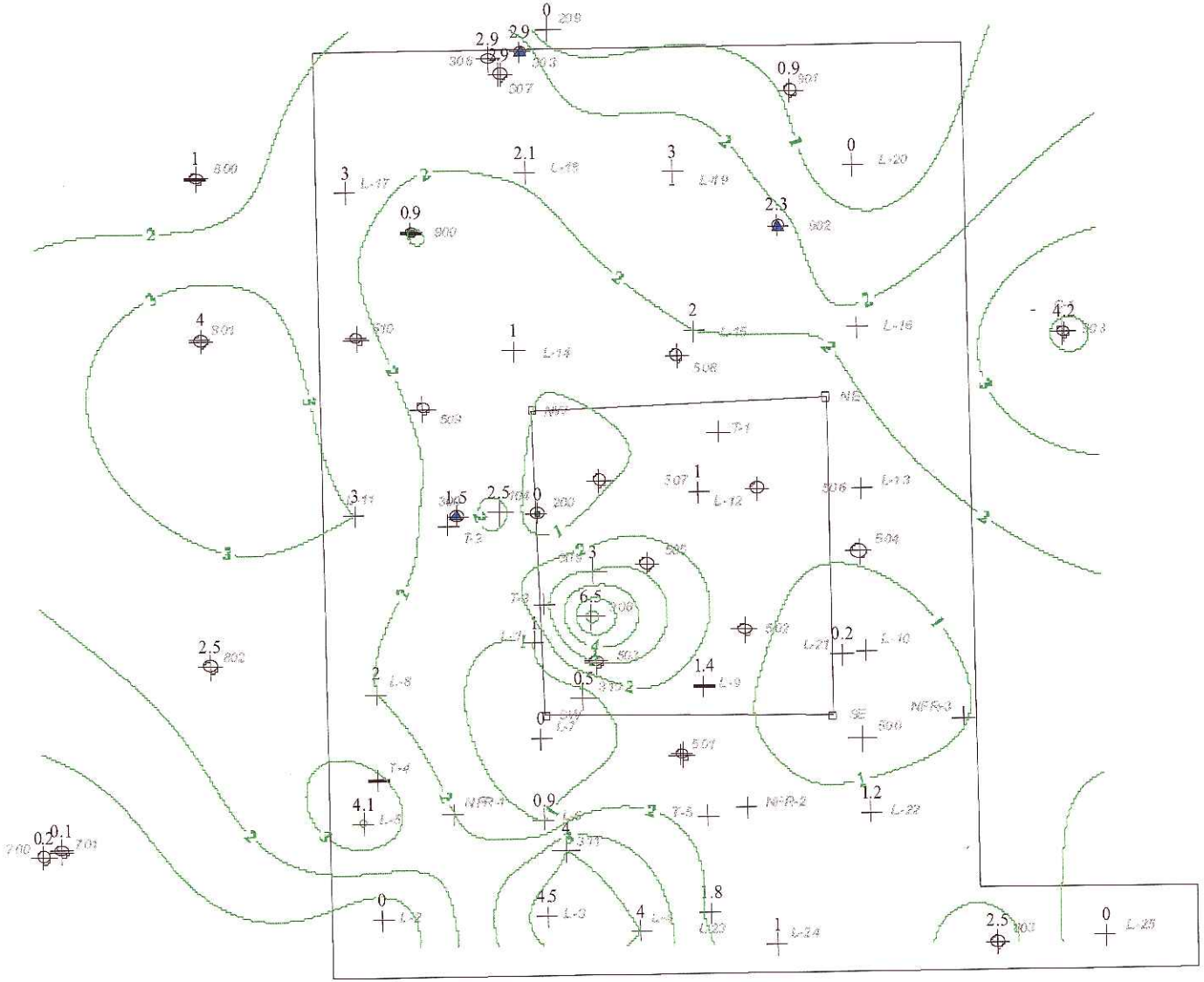
SHARP and Associates, Inc. Environmental Engineers and Scientists 982 Crupper Ave. • Columbus, OH 43229	DATE: 6/20/2003 SCALE: Approx. Contour Interval: 1 Foot PROJECT: 2116	**Structure Map** Top of the Gray Unoxidized Till, Feet above Mean Sea Level	**Figure 11**



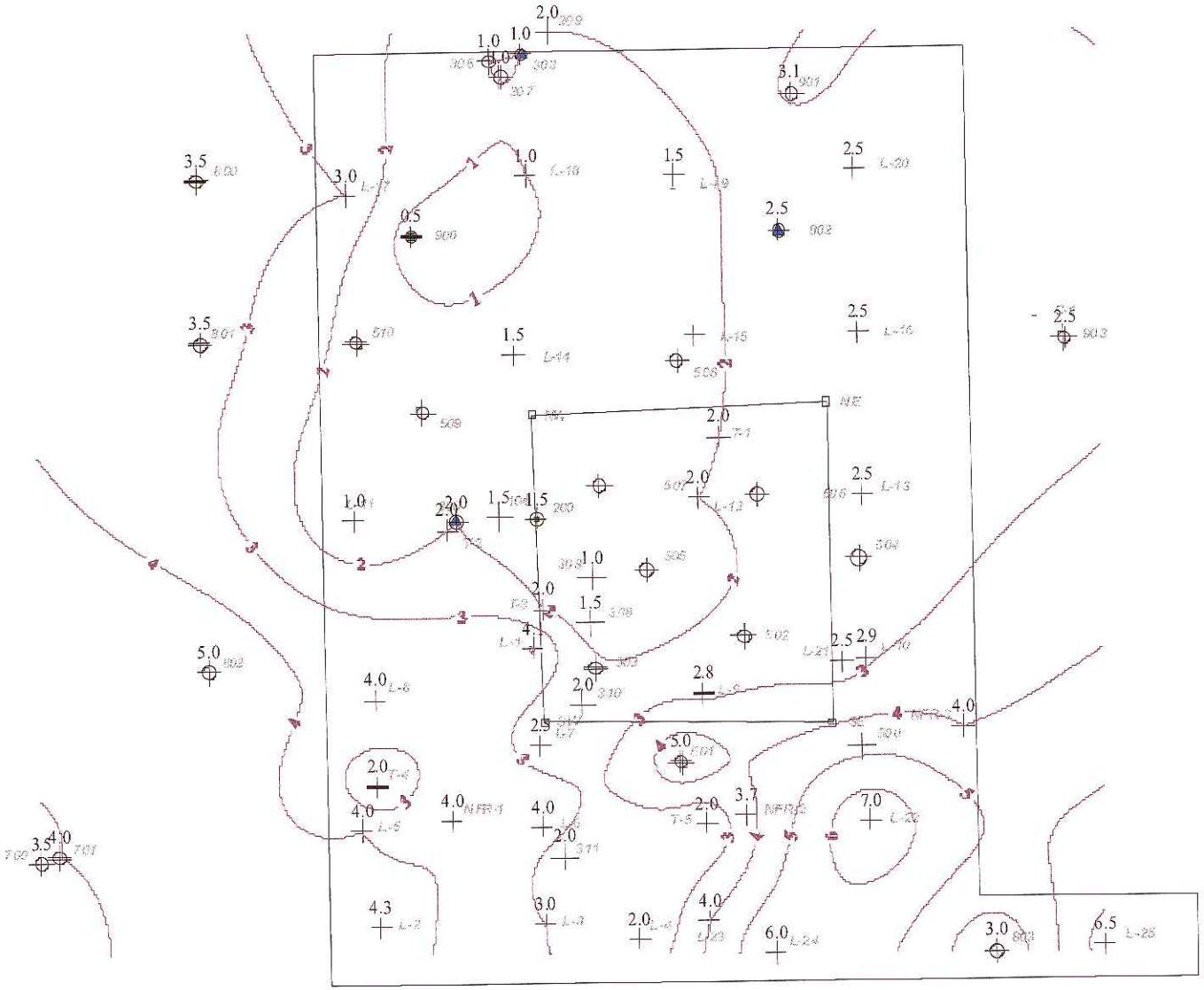
SHARP and Associates, Inc. Environmental Engineers and Scientists 982 Crupper Ave. • Columbus, OH 43229	**DATE:** **SCALE:** Approx. **Contour Interval:** 1 Foot **PROJECT:** 2116	**Structure Map** Base of the Silt, Feet above Mean Sea Level	**Figure 12**



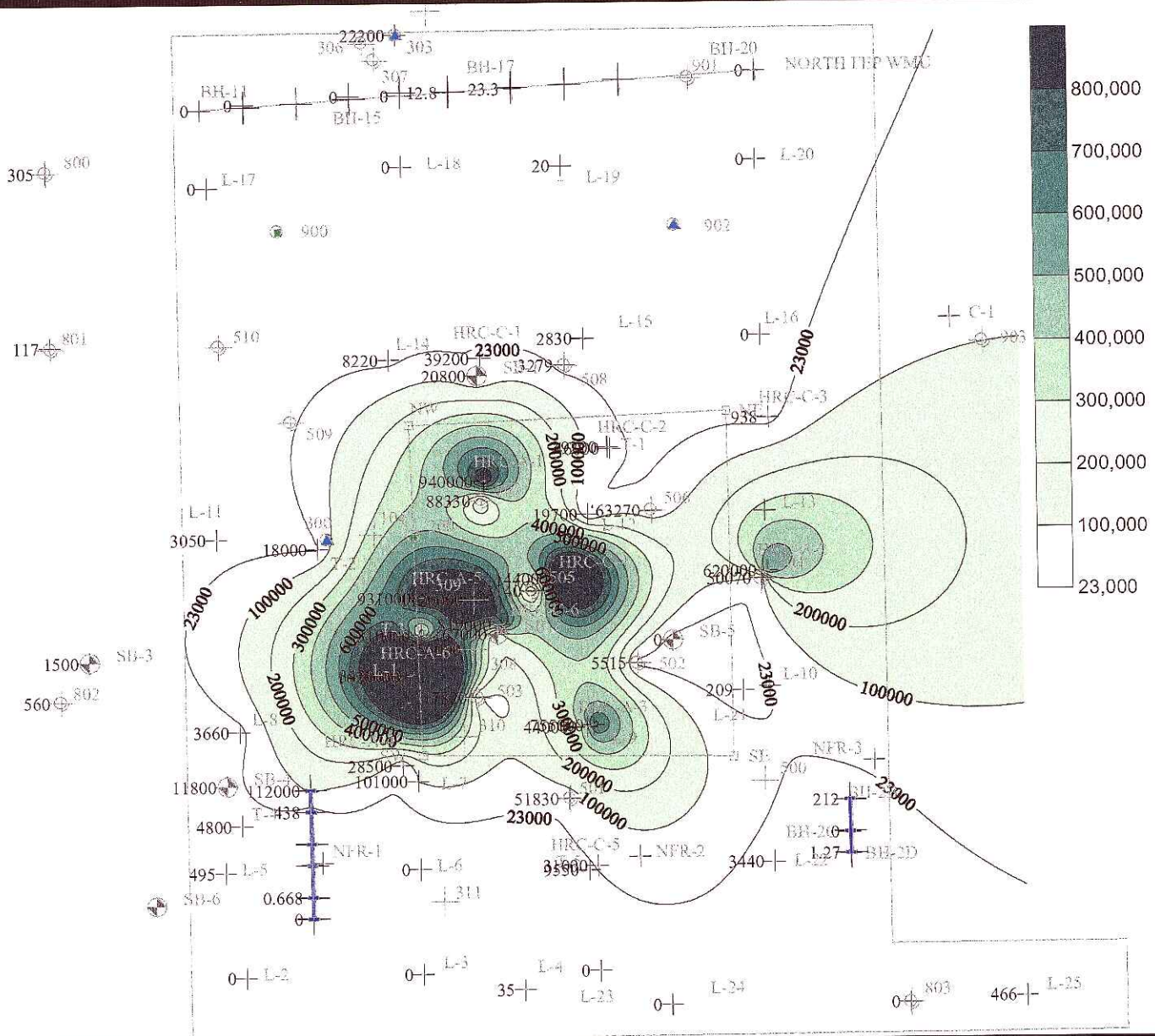
SHARP and Associates, Inc. Environmental Engineers and Scientists 982 Crupper Ave. • Columbus, OH 43229	**DATE**: 6/20/2003 **SCALE**: Approx. **Contour Interval**: 1 Foot **PROJECT**: 2116	**Structure Map** Base of the Topsoil/Fill Feet above Mean Sea level	**Figure 13**



SHARP and Associates, Inc. Environmental Engineers and Scientists 982 Crupper Ave. • Columbus, OH 43229	**DATE**: 6/2/2003 **SCALE**: (Approx.) **Isopach Interval**: 1 Foot **PROJECT**: 2116	**Gross Isopach** Feet of Silt Within the Brown Till	**Figure 14**

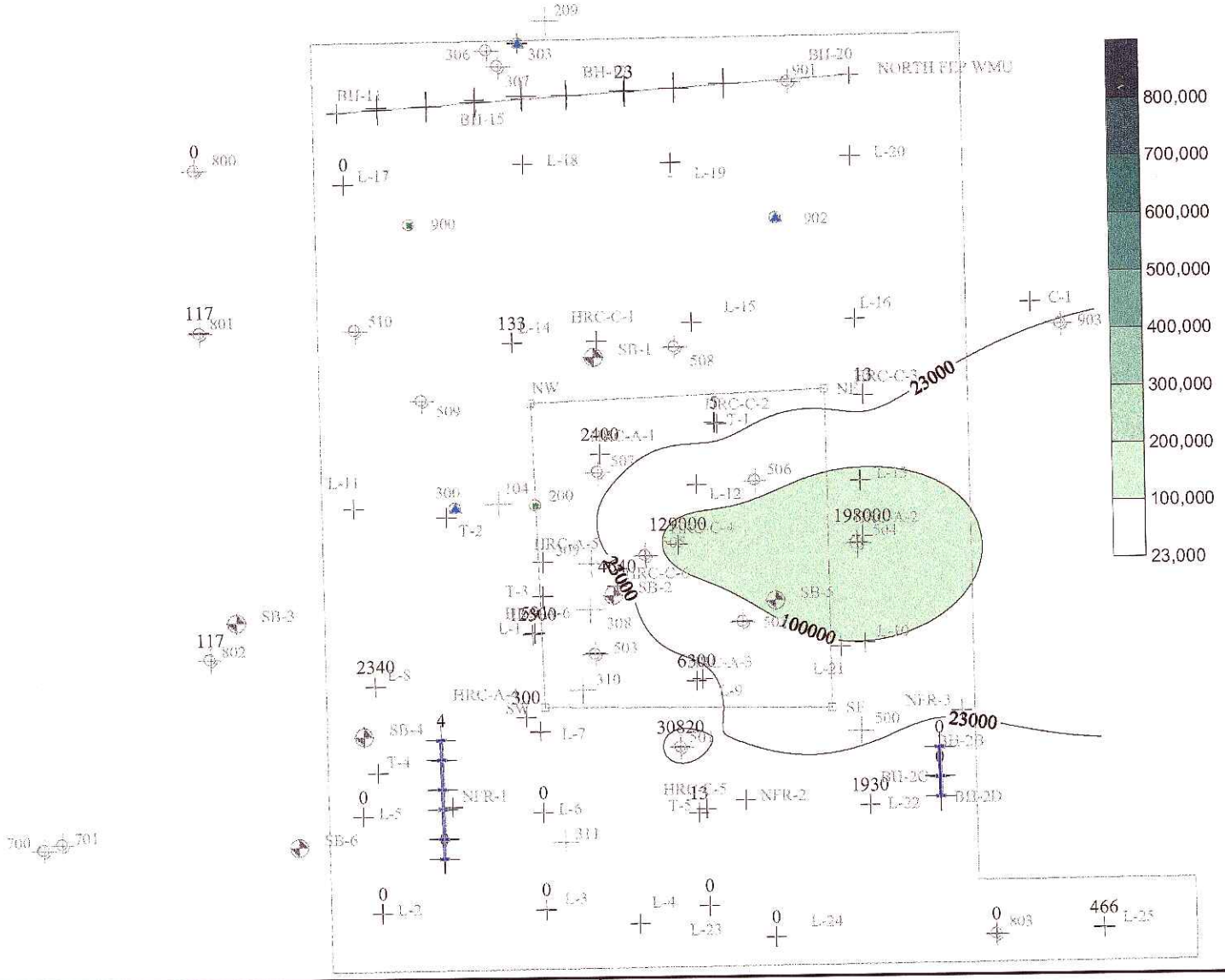


SHARP and Associates, Inc. Environmental Engineers and Scientists 982 Crupper Ave. • Columbus, OH 43229	DATE: 6/2/2003 SCALE: (Approx.) Contour Interval 1 Foot PROJECT: 2116	**Gross Isopach** Feet of Topsoil/Fill	**Figure 15**

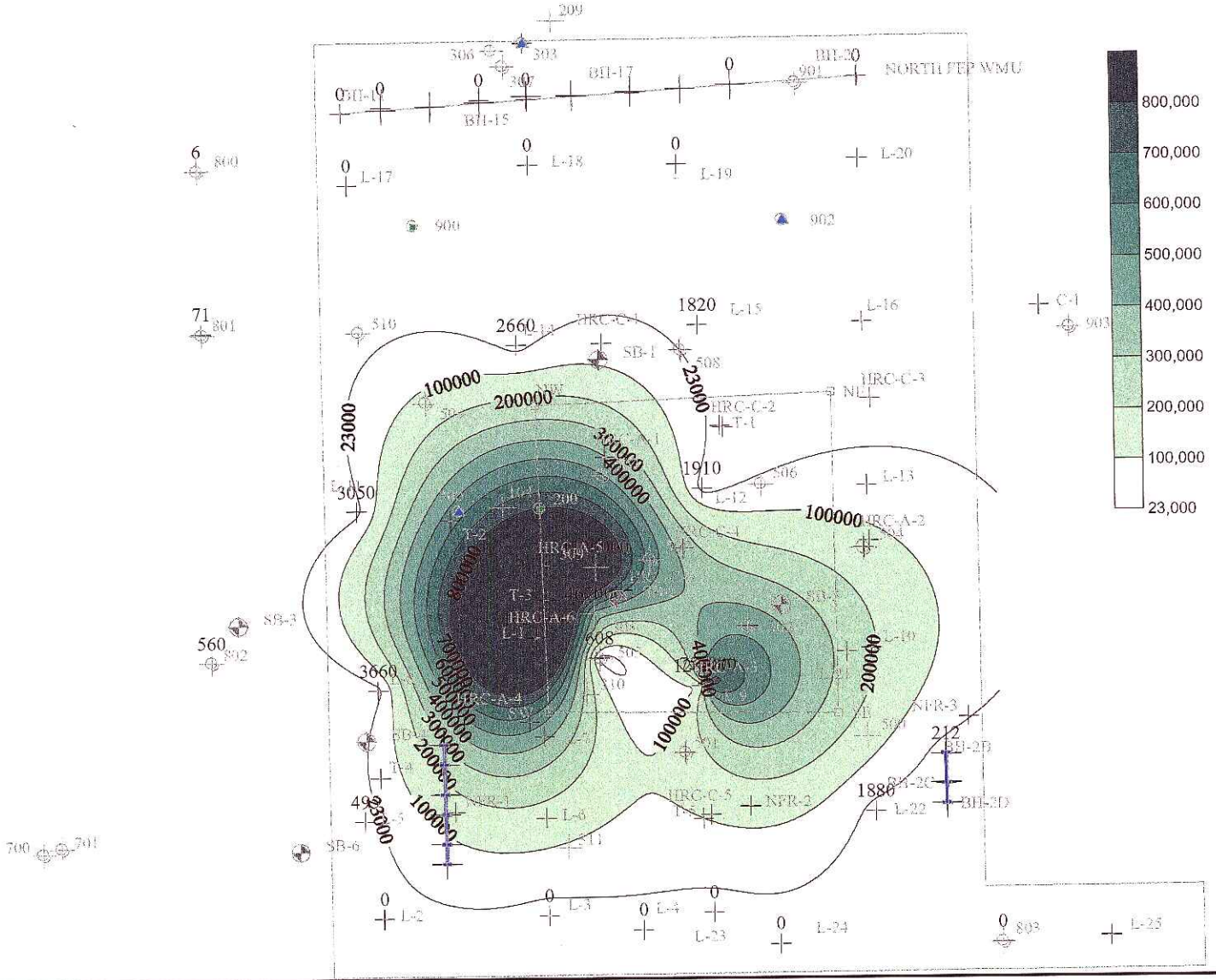


SHARP and Associates, Inc. Environmental Engineers and Scientists 982 Crupper Ave. • Columbus, OH 43229	**DATE**: 6/2/2003 **SCALE**: (Approx.) **PROJECT**: 2116	**Isoconcentration Map** Maximum Concentration of TCE All Data Concentration in µg/kg

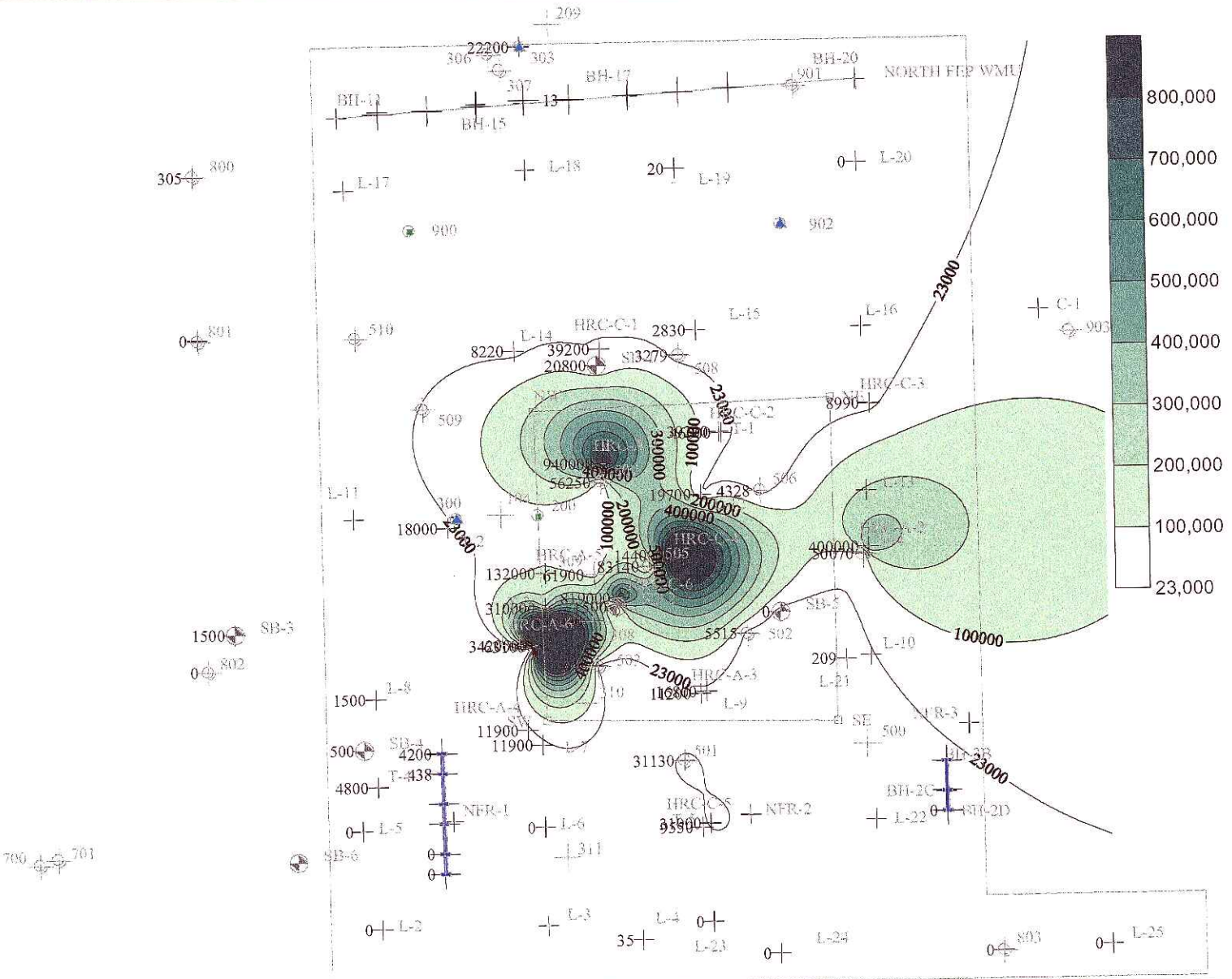
Figure 16



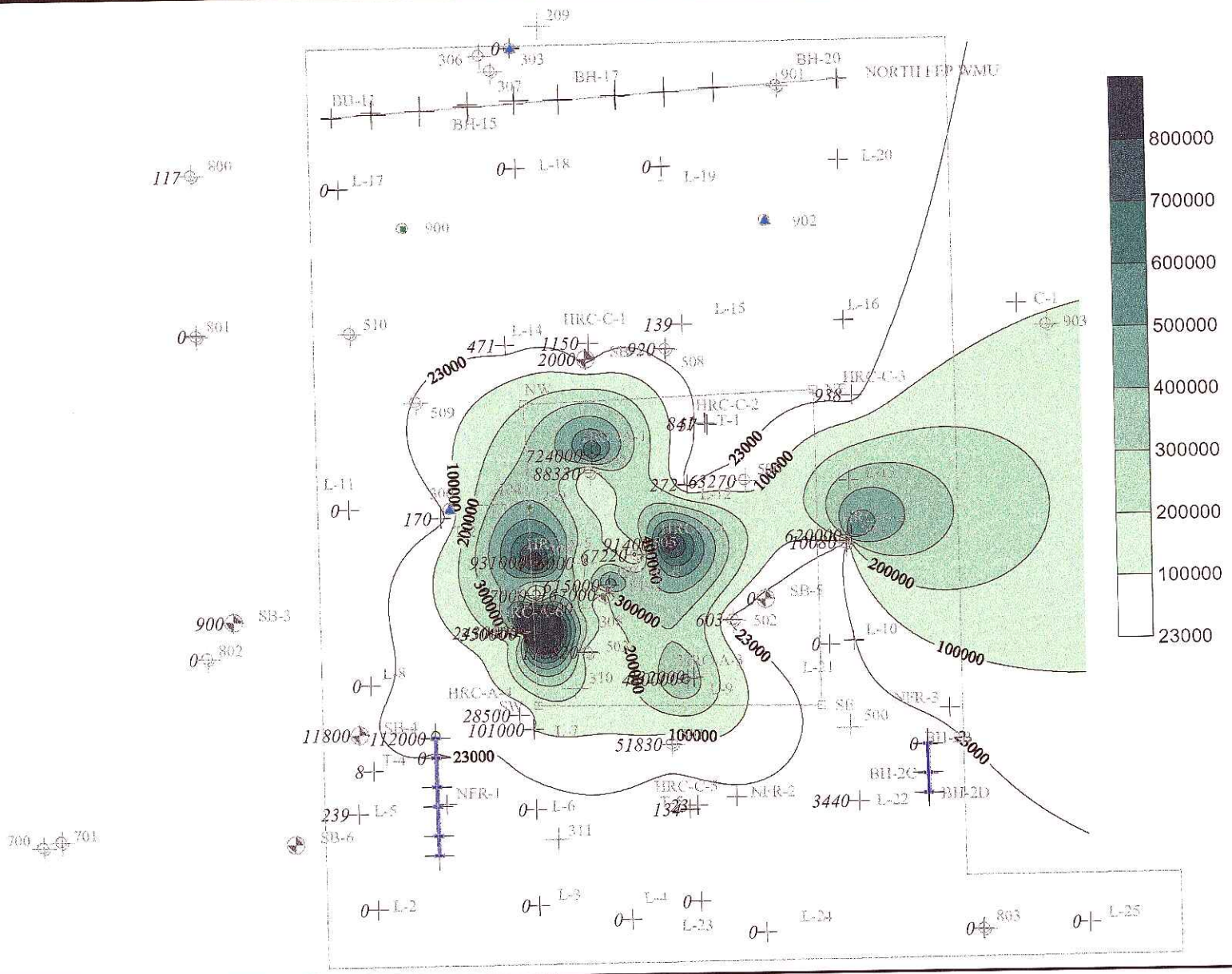
SHARP and Associates, Inc. Environmental Engineers and Scientists 982 Crupper Ave. • Columbus, OH 43229	DATE: 6/2/2003 SCALE: (Approx.) PROJECT: 2116	**Isoconcentration Map** Maximum Concentration of TCE Within The Fill Concentration in µg/kg	**Figure 17**



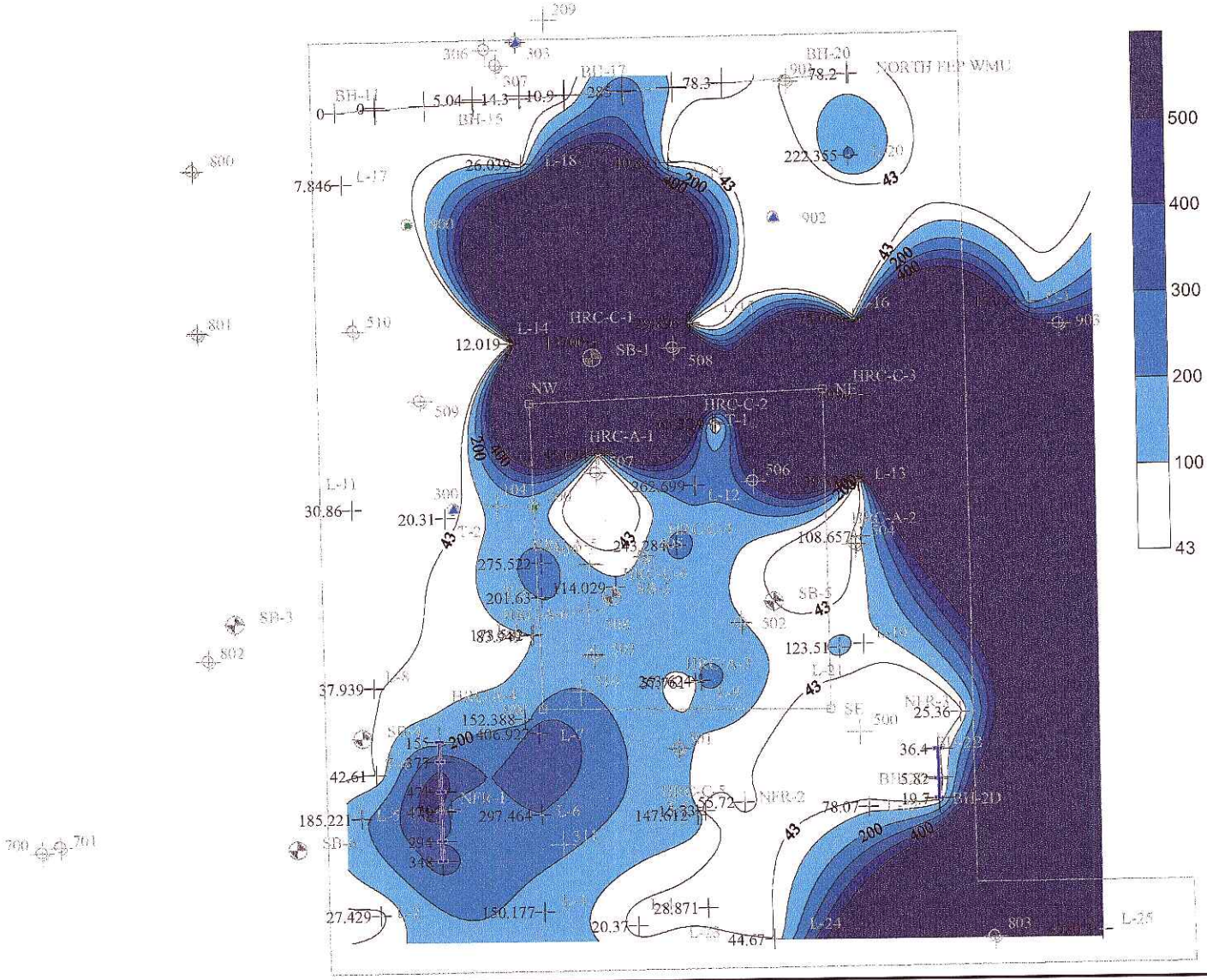
SHARP and Associates, Inc. Environmental Engineers and Scientists 982 Crupper Ave. • Columbus, OH 43229	**DATE**: 6/2/2003 **SCALE**: (Approx.) **PROJECT**: 2116	**Isoconcentration Map** Maximum Concentration of TCE Within The Silt Concentration in µg/kg	**Figure 18**



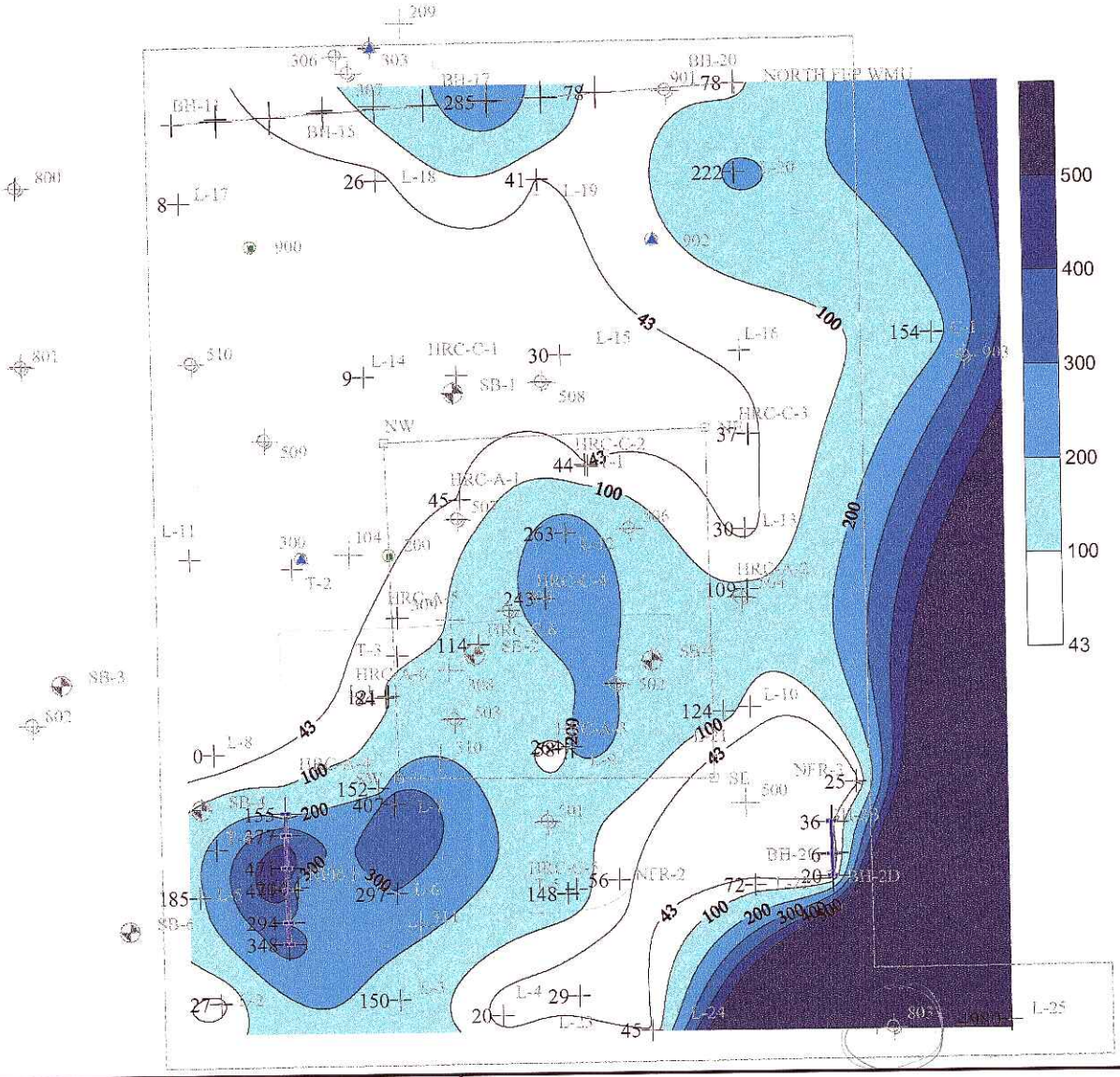
SHARP and Associates, Inc. Environmental Engineers and Scientists 982 Crupper Ave. • Columbus, OH 43229	**DATE**: 6/2/2003 **SCALE**: (Approx.) **PROJECT**: 2116	**Isoconcentration Map** Maximum Concentration of TCE Within The Brown Till Concentration in µg/kg	**Figure 19**



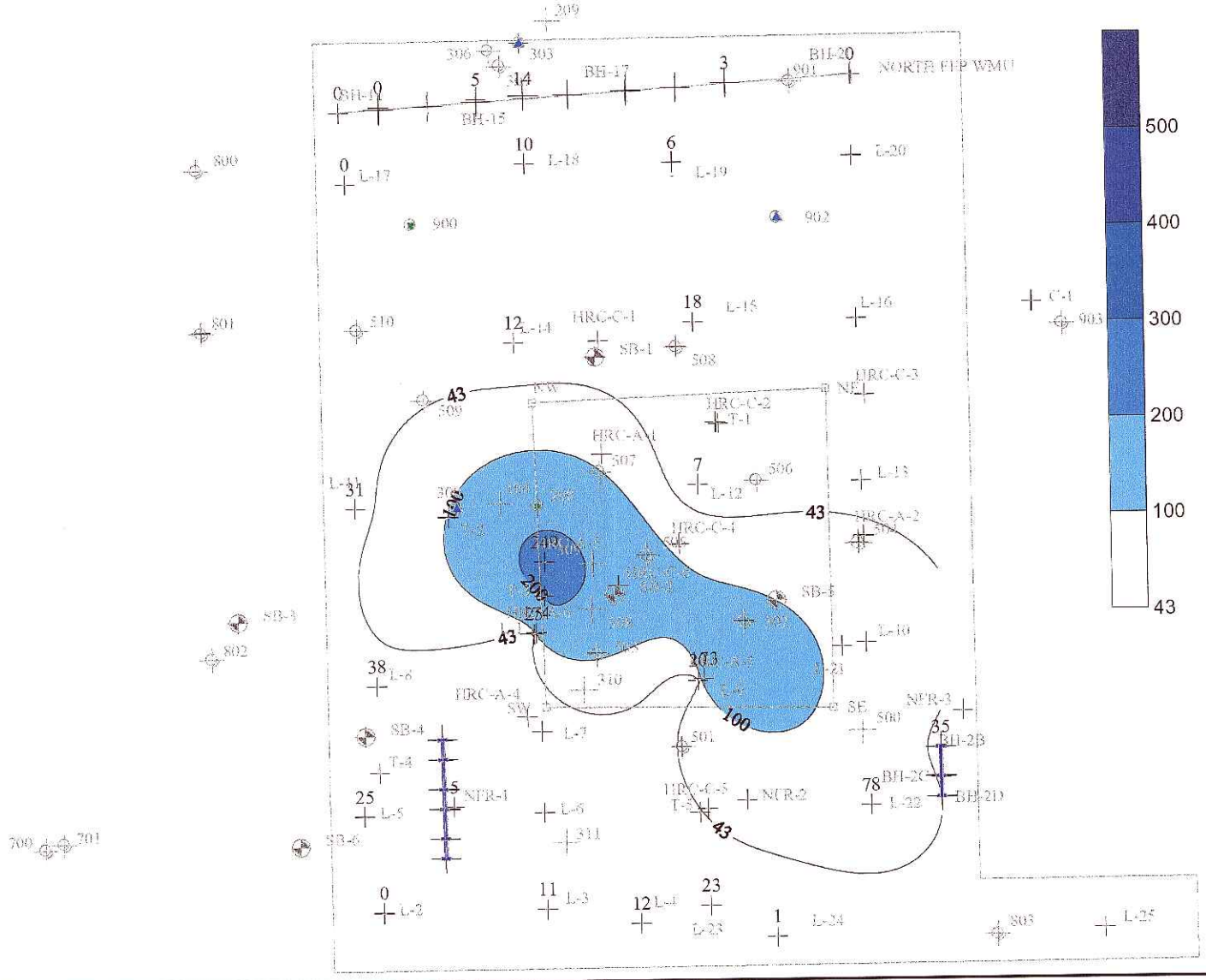
SHARP and Associates, Inc. Environmental Engineers and Scientists 982 Crupper Ave. • Columbus, OH 43229	**DATE**: 6/2/2003 **SCALE**: (Approx.) **PROJECT**: 2116	**Isoconcentration Map** Maximum Concentration of TCE Within The Gray Till Concentration in µg/kg	**Figure 20**



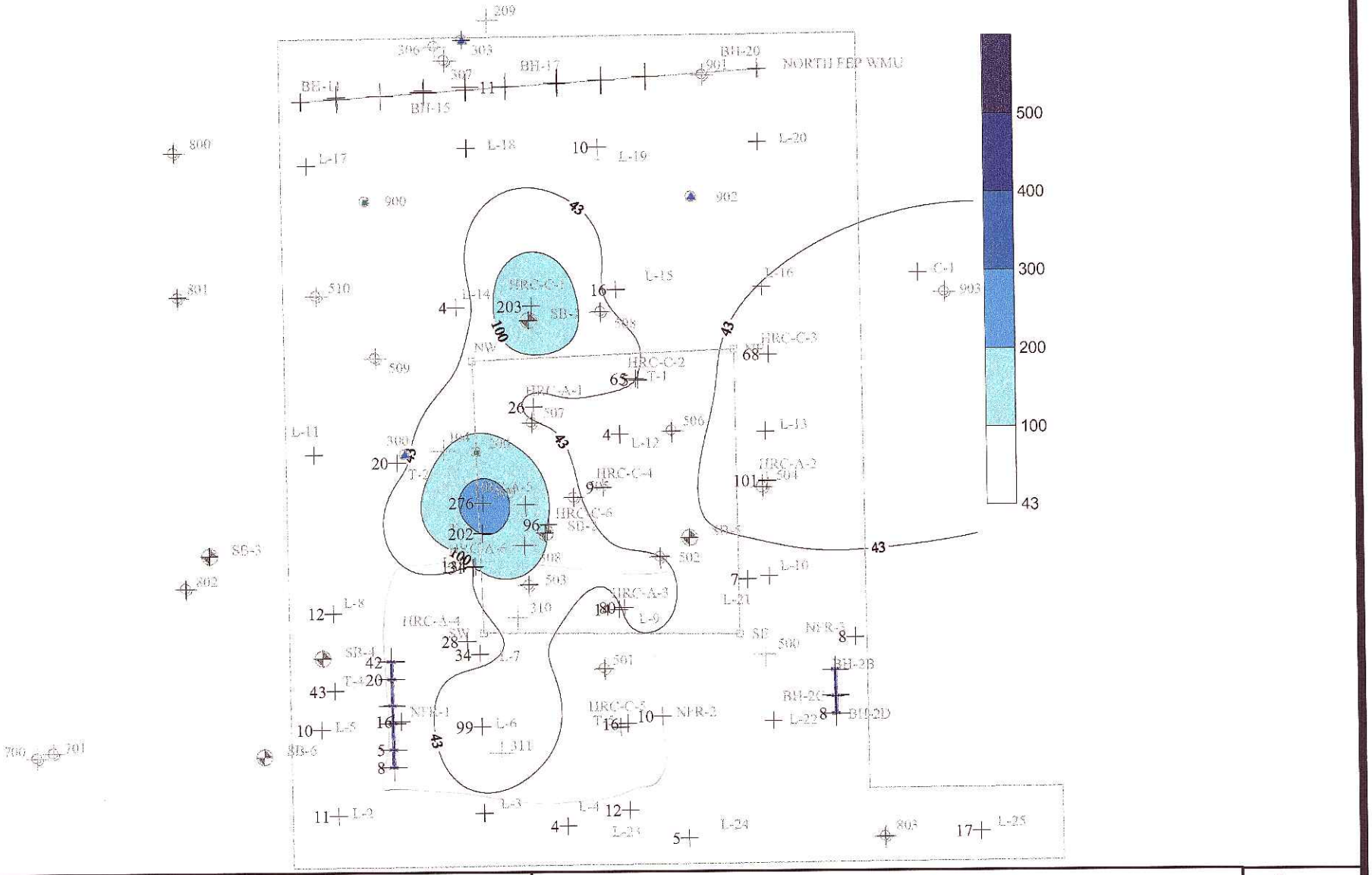
SHARP and Associates, Inc. Environmental Engineers and Scientists 982 Crupper Ave. • Columbus, OH 43229	DATE: 6/2/2003 SCALE: (Approx.) PROJECT: 2116	**Isoconcentration Map** Maximum Concentration of Total Uranium All Data Concentration in mg/kg	**Figure 21**



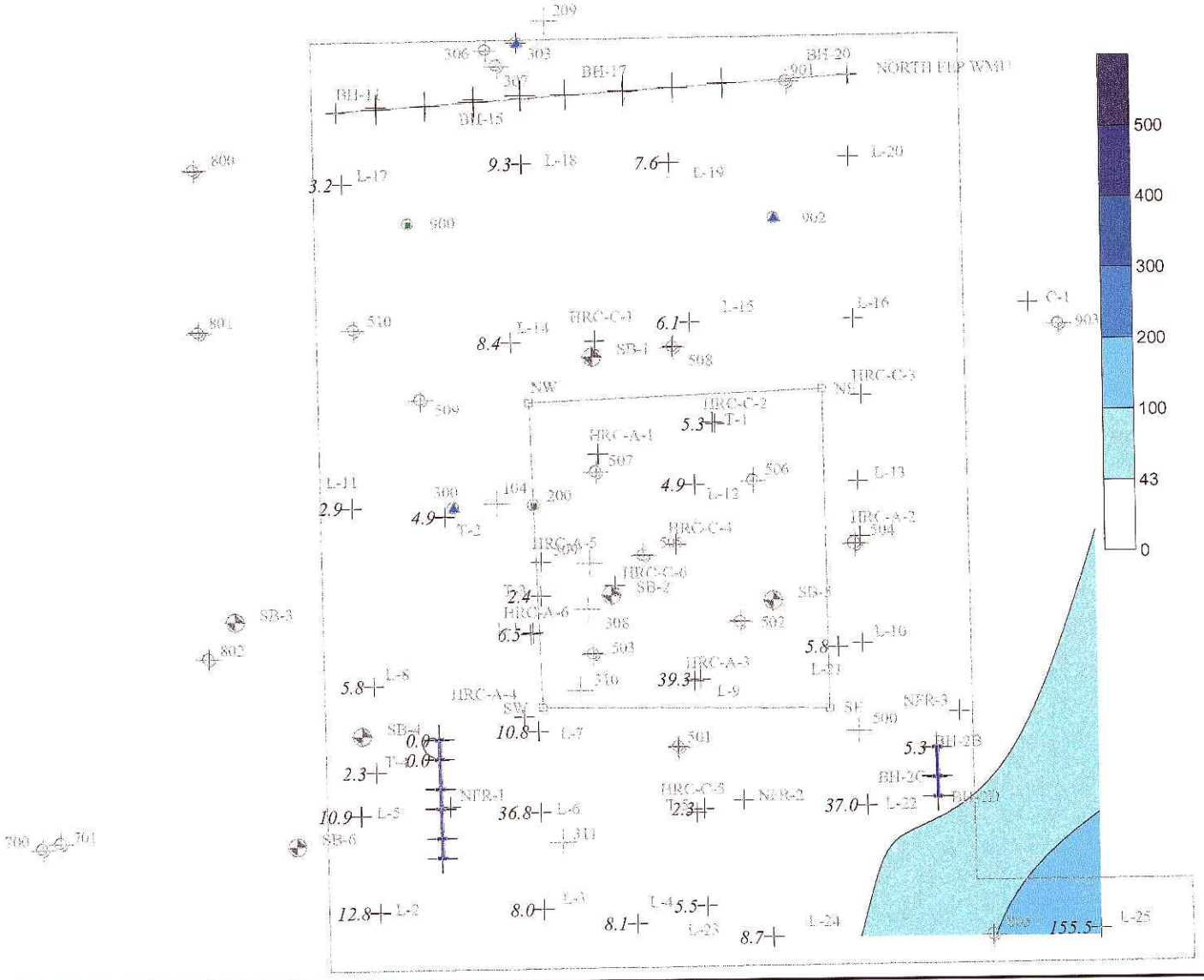
SHARP and Associates, Inc. Environmental Engineers and Scientists 982 Crupper Ave. • Columbus, OH 43229	**DATE**: 6/2/2003 **SCALE**: (Approx.) **PROJECT**: 2116	**Isoconcentration Map** Maximum Concentration of Total Uranium Within The Fill Concentration in mg/kg	**Figure 22**



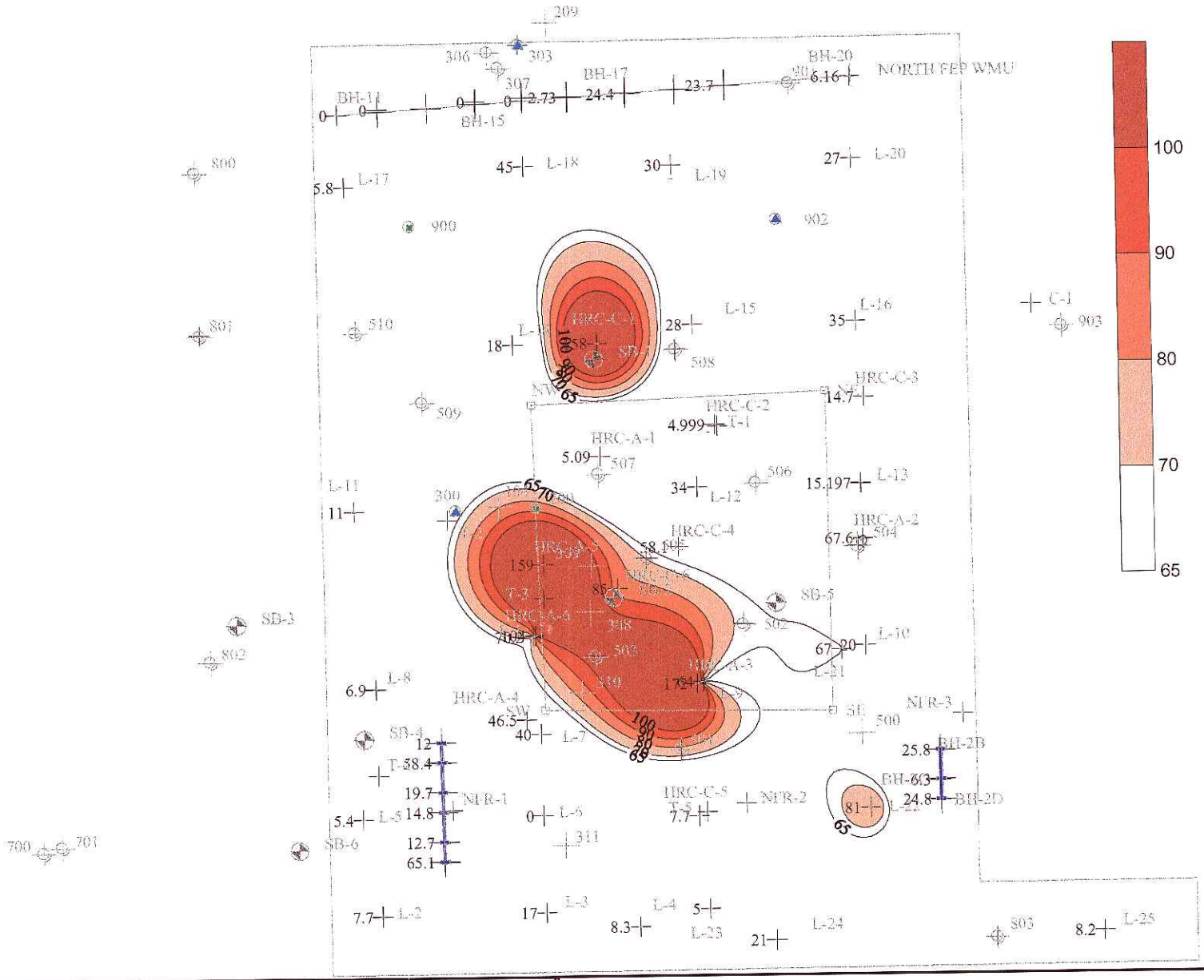
SHARP and Associates, Inc. Environmental Engineers and Scientists 982 Crupper Ave. • Columbus, OH 43229	DATE: 6/2/2003 SCALE: (Approx.) PROJECT: 2116	**Isoconcentration Map** Maximum Concentration of Total Uranium Within The Silt Concentration in mg/kg	**Figure 23**



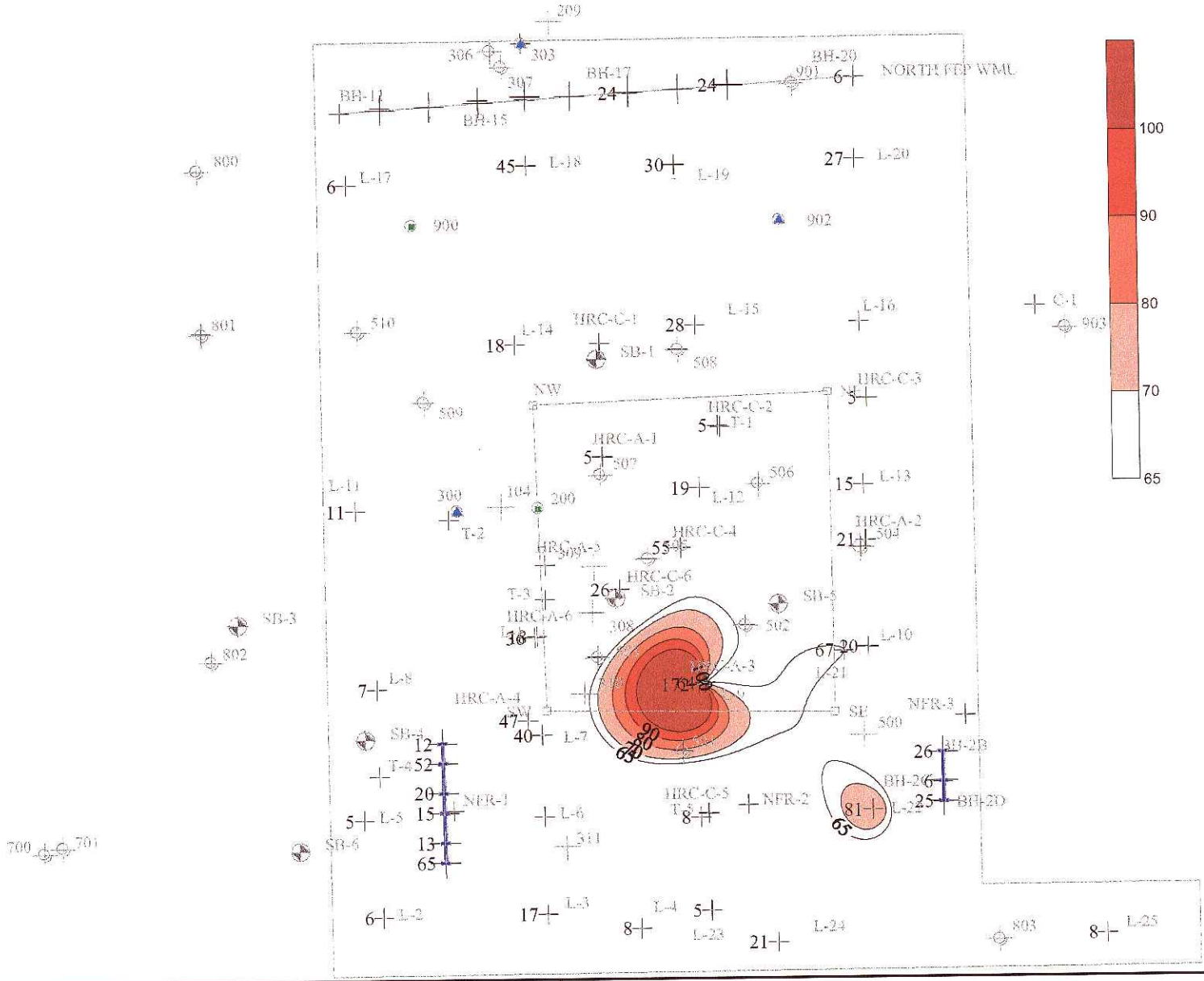
SHARP and Associates, Inc. Environmental Engineers and Scientists 982 Crupper Ave. • Columbus, OH 43229	**DATE**: 6/2/2003 **SCALE**: (Approx.) **PROJECT**: 2116	**Isoconcentration Map** Maximum Concentration of Total Uranium Within The Brown Till, Concentration in mg/kg	**Figure 24**



SHARP and Associates, Inc. Environmental Engineers and Scientists 982 Crupper Ave. • Columbus, OH 43229	DATE: 6/2/2003 SCALE: (Approx.) PROJECT: 2116	**Isoconcentration Map** Maximum Concentration of Total Uranium Within The Gray Till, Concentration in mg/kg	**Figure 25**

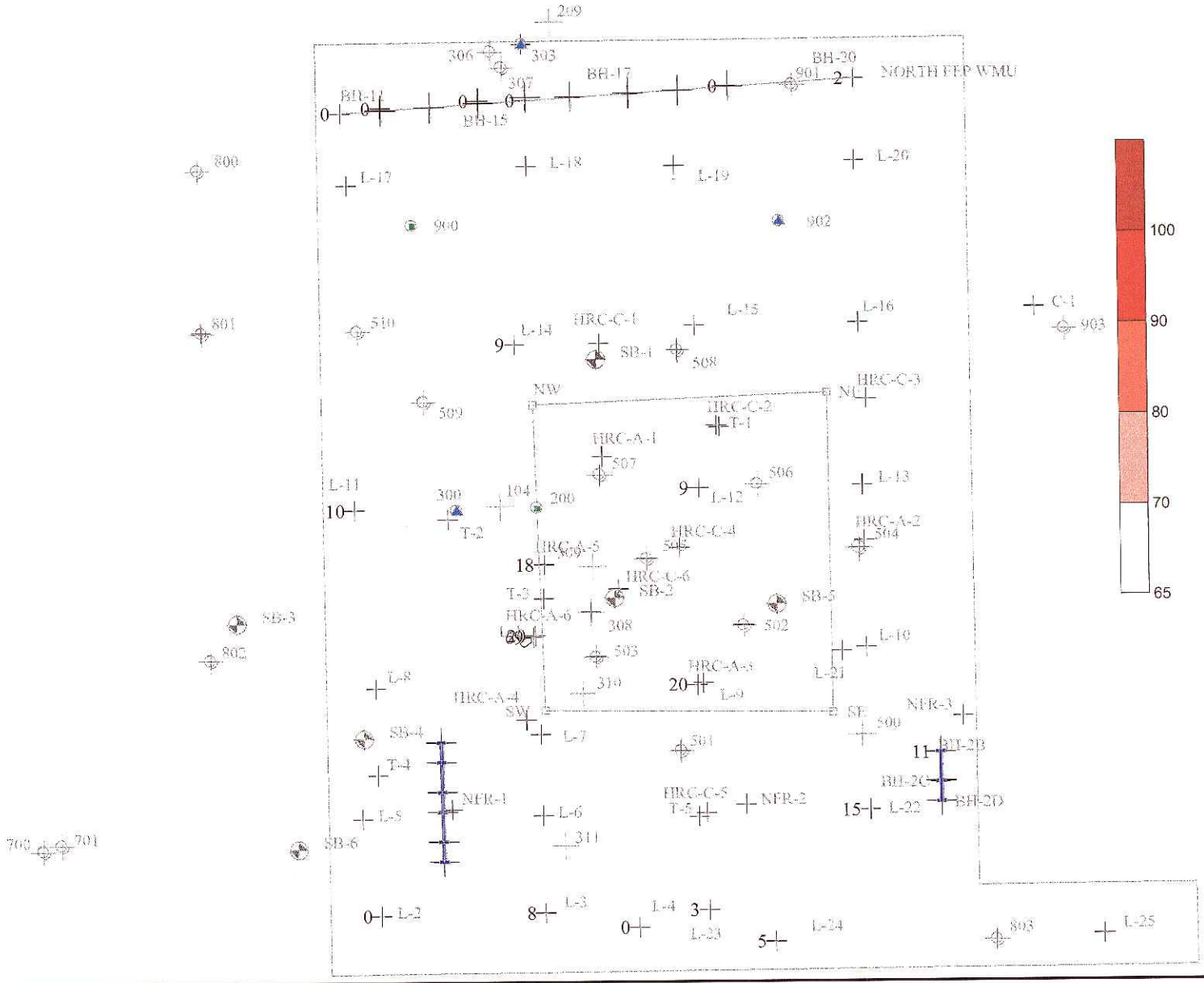


SHARP and Associates, Inc. Environmental Engineers and Scientists 982 Crupper Ave. • Columbus, OH 43229	DATE: 6/2/2003 SCALE: (Approx.) PROJECT: 2116	**Isoconcentration Map** Maximum Concentration of Technecium-99 All Data Concentration in pCi/g	**Figure 26**



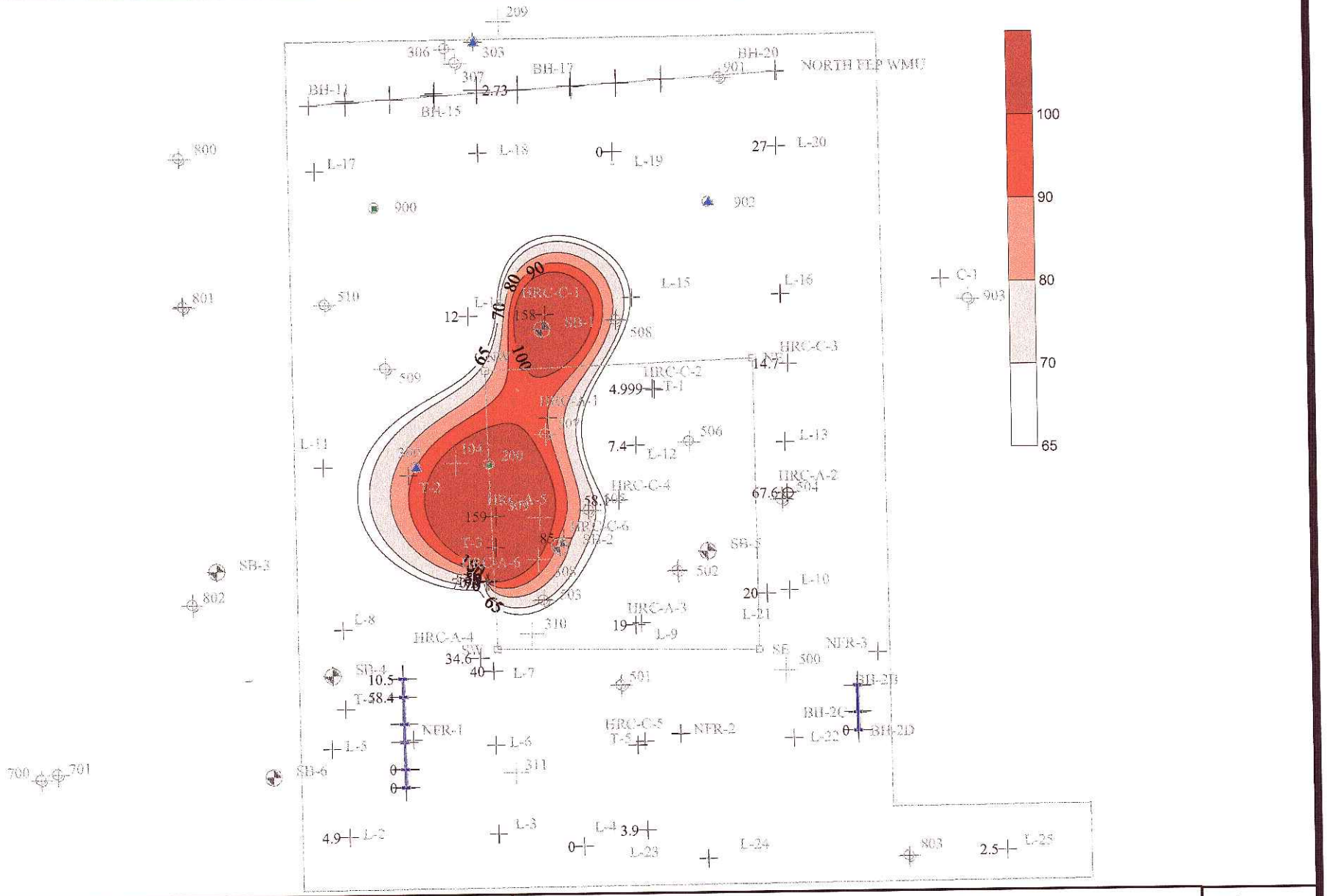
SHARP and Associates, Inc. Environmental Engineers and Scientists 982 Crupper Ave. • Columbus, OH 43229	**DATE**: 6/2/2003 **SCALE**: (Approx.) **PROJECT**: 2116	**Isoconcentration Map** Maximum Concentration of Technicium-99 Within The Fill Concentration in pCi/g

Figure 27



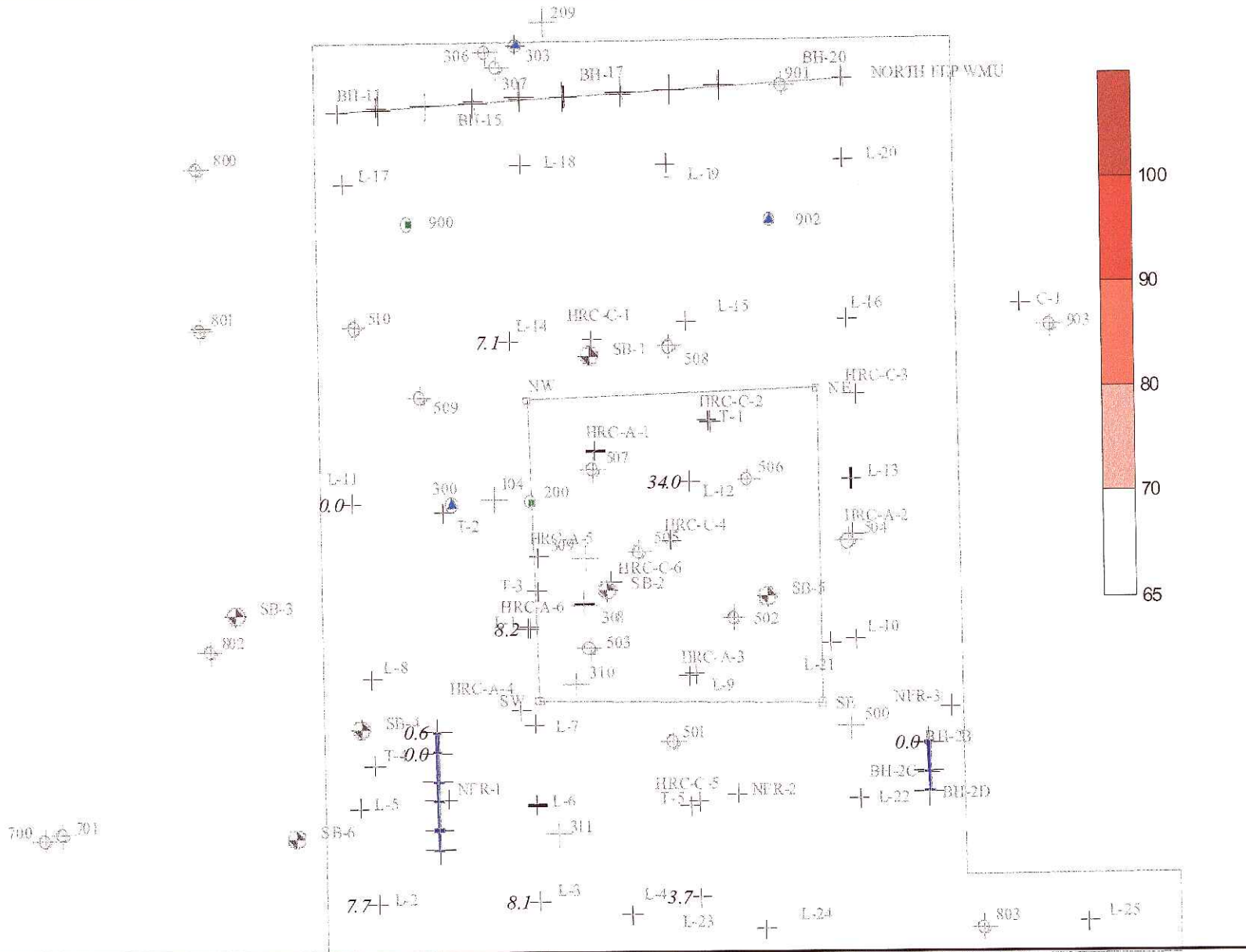
SHARP and Associates, Inc. Environmental Engineers and Scientists 982 Crupper Ave. • Columbus, OH 43229	**DATE**: 6/2/2003 **SCALE**: (Approx.) **PROJECT**: 2116	**Isoconcentration Map** Maximum Concentration of Technicium-99 Within The Silt Concentration in pCi/g

Figure 28



SHARP and Associates, Inc. Environmental Engineers and Scientists 982 Crupper Ave. • Columbus, OH 43229	DATE: 6/2/2003 SCALE: (Approx.) PROJECT: 2116	**Isoconcentration Map** Maximum Concentration of Technicium-99 Within The Brown Till, Concentration in pCi/g

Figure 29



SHARP and Associates, Inc. Environmental Engineers and Scientists 982 Crupper Ave. • Columbus, OH 43229	**DATE**: 6/2/2003 **SCALE**: (Approx.) **PROJECT**: 2116	**Isoconcentration Map** Maximum Concentration of Technicium-99 Within The Gray Till, Concentration in pCi/g	**Figure 30**